

## **Strypi IX — More Power, Higher Velocity**

Strypi IX, the latest "mod" of the Sandia-developed Strypi family of rockets, serves as the launch vehicle for advanced RVs (reentry vehicles).

Strypi rockets date back to the early 1960s, when the first Strypi was developed on a crash basis for use as a carrier vehicle for high altitude nuclear tests in the South Pacific. That's a story in itself (see box). Strypi has long been considered one of the workhorses in the Sandia rocket program.

The latest version — Strypi IX — is a two-stage, solid propellant rocket system designed to boost reentry payloads to moderate reentry velocities (about 12,500 feet per second). With a more powerful upper stage motor than its predecessors, it can achieve higher velocities and carry payloads farther downrange.

During FY85 three Strypi IXs, two with simulated payloads and one with a highly instrumented advanced RV aboard, were launched from Kauai to a target near Johnston Island, about 650 miles away.

If you could travel with an RV aboard the Strypi IX, you'd be in for a fast ride, at least by human standards. The fin-stabilized main first-stage booster motor is a Castor I, augmented by two Recruit auxiliary boosters that increase acceleration while on the launcher and reduce effects of thrust misalignment and wind. The rocket clears the launch rail at a velocity of 100 feet per second (fps) after simultaneous ignition of the Castor I and Recruit boosters. At first-stage burnout, 43 seconds into the flight, the Strypi is speeding along at more than 4300 fps (3000 miles per hour).

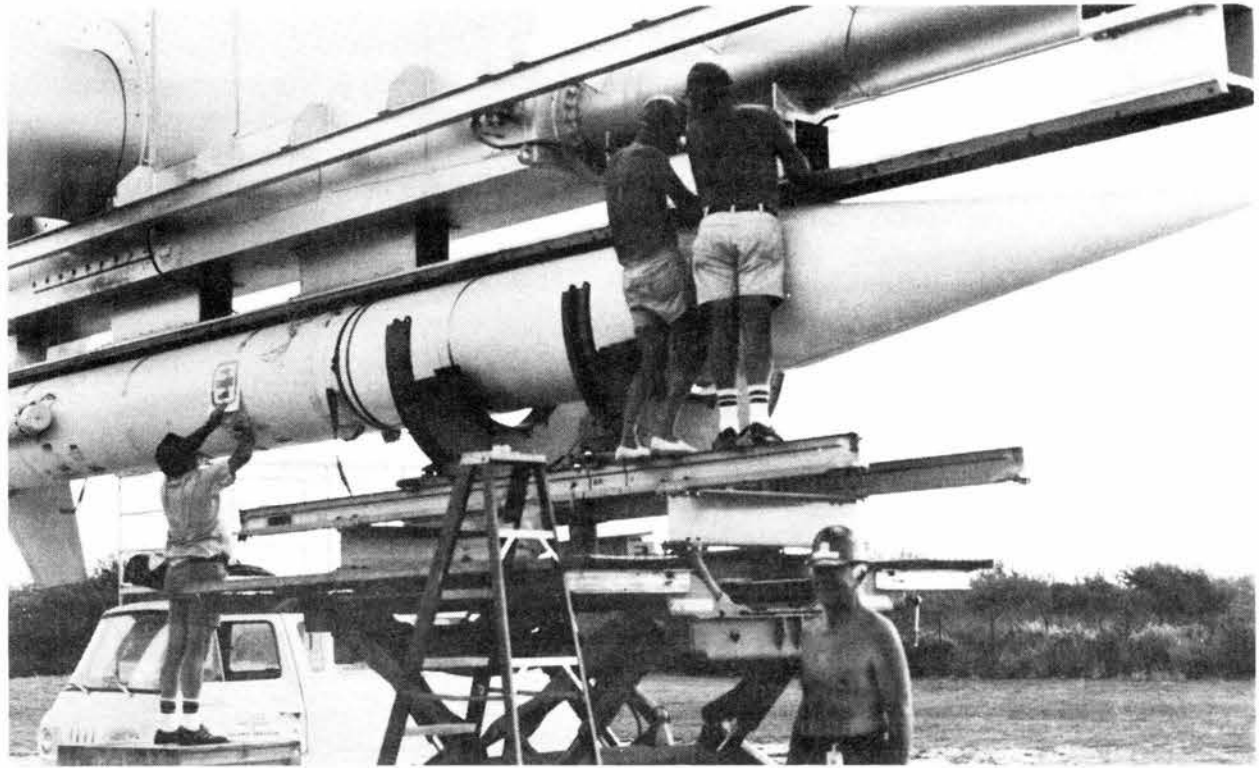
After first stage booster separation, and before second stage ignition, the rocket's Attitude Control System (ACS) changes the orientation of the spinning second stage to a predetermined pitch and yaw attitude. A SANDAC computer (LAB NEWS, Aug. 16, 1985) in the RV calculates these angles based on navigation data obtained by on-board sensors.

The rocket's second stage, an Antares II, ignites about 150 seconds into the flight and burns for 35 seconds. Velocity at burnout is slightly less than 12,200 fps (almost 8300 mph).

During the "coast" following second stage burn, the ACS again reorients the second stage to align the RV with the flight path. On command from the launch site, the RV separates from the second stage at 350,000 feet altitude. As it descends to 250,000 feet, it is traveling at a speed of 12,580 fps (just under 8600 mph).

The Strypi flights in FY85 were outstanding successes and the wealth of data collected is still being analyzed.

Many people from different Labs organizations work together to make Sandia's rocket program the success it is. It's very much a team effort. The Rocket System Division 7525 under Dick Eno is responsible for the design and assembly of the Strypi system, telemetry, ACS, and launch operations. Aerospace Projects Division 1635 under Bill Barton has the responsibility for aerodynamics and aeroballistics.



PRE-LAUNCH CHECKS on Strypi IX are made by (l to r) Dan Talbert, Lee Stone (both 7525), and Jack Bahlman (1653) at Kauai Test Facility. Bill Walker (DMTS, 7525), below, is project leader for Strypi vehicle systems. The two-stage Strypi IX is almost 40 feet long and is 31 inches in diameter.



# **LAB NEWS**

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## **Strypi: What's in a Name?**

Back in 1961, resumption of full-scale nuclear testing by the Soviet Union after the 1958 moratorium caught the U.S. totally by surprise. In an informal condensed history of the Sandia rocket program written last year, Dick Eno (7525) points out that this country had no carrier system defined or qualified to lift live devices to high altitudes, and no diagnostic instruments — even on paper, let alone hardware — suitable for high altitude rocket deployment.

Of systems then in existence, the Air Force's Thor won the honor of being chosen the device carrier for quick resumption of U.S. high altitude tests, and work began on a Thor launch site at Johnston Island. After a hurry-up effort, live test attempts began in June 1962. However, only one success and a string of failures by the end of July brought test activities to a screeching halt and morale to a new low.

Don Shuster, Jim Scott, and Morgan Kramm (the three headed the Sandia contingent at Johnston), after talking with on-site Sandians and with Glenn Fowler and others in Albuquerque, offered to build an alternate carrier vehicle in time to save the test series. The offer was accepted, and Sandia president "Monk" Schwartz pledged the entire capability of the Labs to the task. Midnight oil burned in offices, drafting rooms, and development shops at Sandia, and Bendix-Kansas City worked around

the clock to build the hardware.

Dick's history recalls that during this period then-VP of Research George Dacey visited Johnston, where he was entertained one night by the Johnston Island commander. Sandia's effort to design a new device carrier was a popular topic at the party. Dacey told a story about the perilous encounter of an English recruit, newly assigned to duty in "Ind-ya," with a tiger whose tail he mistakenly took for the mysterious black and yellow snake called a "Strypi." Since Sandia indeed had a "tiger by the tail" in its quest to produce a reliable carrier in unheard-of time, the name was immediately attached to the carrier.

The first Strypi test flight (sans nuclear device) was successfully completed on Sept. 22, 1962, less than two months after design work began. That flight, and two others, were considered enough to characterize system performance and verify its reliability. But Thor was given one more chance; at sixty thousand feet, the missile went out of control, and the test device and missile had to be destroyed.

Strypi had its day. The Johnston Island crew launched the carrier, with a high altitude device aboard, on Oct. 20. The Checkmate device detonated at the proper point in space. The test series was still alive, and the U.S. regained some measure of its reputation lost in the series of Thor failures.



# Antojitos

**Goodby, George!** As Sandians go, I've not been in the LAB NEWS supervisor slot very long—less than four years. But that brief period has brought all new faces to my line: department, director, vice-president, executive vice-president, and now president. I'm sorry to see George Dacey head into the sunset, even if it does make me the senior member (in terms of longevity, at least) of my line.

Why sorry? Because George is one of the great communicators, right up there with our other president, the nation's. I appreciate George's ability to communicate a complex idea, juggling the main concept along with the qualifiers and the exceptions and the nuances and ending up with a clear presentation of the idea. I appreciate his skill at creating aphorisms—phrases so vivid they stick in the memory: "We don't want to run a plush-lined rut here. We want this to be a Mt. Everest." And I appreciate his sense of humor—he doesn't feel constrained by his position into taking himself or Sandia totally seriously all the time.

I think these skills come through again in this issue's State of the Labs message. The tradition of running such a message goes back to George's predecessor, Morgan Sparks, who shared his views on Sandia with LAB NEWS readers in January 1980. In the years since, the annual message has contributed, I hope significantly, to an enlightened employee body. Recognizing that such enlightenment heightens morale, increases performance, and decreases the output of the rumor mill, George and the LAB NEWS have amplified the message to include a wider range of subjects and a greater depth of coverage for each one.

After working with George's successor, Irwin Welber, on this year's State of the Labs message, I'm confident that trend will continue—he strikes me as every bit as devoted to the cause of open communications as George has been.

That's important, because the State of the Labs message, along with the Technical Accomplishments section that accompanies it, also serves these days as a kind of "annual report" on Sandia to policy makers in DOE, Congress, AT&T, and the nuclear weapons complex. . . .

. . . Which, I fervently hope, makes all the effort at the top end of the line and here at the bottom worthwhile. This issue represents a major effort by 3160 secretary Marylee Adams, who took 62 pages of shorthand during four hours of discussions during December with George, Irwin, and Executive VP Tom Cook and produced some 79 pages of typed transcript; transcriptionist Rose Ann Shultz (2613) also aided in the project. The three executives, along with Charlie Winter (400), Dick Craner and others in Classification, Larry Greher in Legal, and Jim Mitchell in Public Affairs, have helped me distill those pages down to what you see here; I don't know how much time they've devoted to reviewing the drafts involved, but my computer tells me I've spent 48 hours at the keyboard.

LAB NEWS writer Phyllis Wilson, with (again) Charlie Winter's and Dick Craner's help, has had the task of refining 120 or so 1985 Technical Accomplishments write-ups into final form. And I must thank the technical organizations and their managers, through vice-presidents, who screened the entire year's accomplishments and chose no more than 20 per organization for this year's "we're proud of these" list. ●BH

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"Sandia National Laboratories is the best-managed federal lab in the country." —George Keyworth, President Reagan's former science advisor (and former Los Alamos employee), quoted in Albuquerque Tribune.

## Fun & Games

**Bowling** — SANDOE Bowlers-of-the-Month for December were Reyes Chavez (7474) and Jennifer Simmons (2831), men's and women's scratch series; and Mike Carson (7815) and Estella Creel, men's and women's handicap series.

Winners of the No Tap/Scotch Doubles Tournament Jan. 18-19 were Ruth (3150) and Ken (2542) Varga. Second place went to Nick and Paula Gonzales.

\* \* \*

**Downhill Skiing** — Sites for the New Mexico Multiple Sclerosis Society's Ski Extravaganza in February are Red River on Feb. 15 and Sandia Peak on Feb. 22 (weather permitting). The annual Extravaganza is a pledged event with prizes in all categories and a super trip for the top fund raiser. Call the MS Society at 888-4948 for an info brochure and registration form.

\* \* \*

**Horseshoes** — New officers of the Sandia Labs Horseshoe Club are: Steve Mahnesmith (2852), president; Tommy Barreras (2852), vice president; and Lupe Massoth (2632), secretary/treasurer. More info on the club is available from any of the officers.

\* \* \*

**More Bowling** — Don't forget "Bowl for Kids' Sake" (to benefit Big Brothers/Big Sisters of Albuquerque) on Feb. 15 from 1:30-5 p.m. at Leisure Bowl, 7400 Lomas NE. Line up your family and friends as sponsors for your game. Besides helping out BB/BS, you may take home one of the prizes donated by sponsors KOB-AM radio, America West Airlines, and Miller High Life. Call 881-2266 for more info and pledge forms.

\* \* \*

**Bike Touring** — Start planning now (and getting in shape) for the Multiple Sclerosis Society's 6th annual MS 150 Bike Tour from Albuquerque to Glorieta May 3-4. Tour participants will stay at Glorieta Baptist Center the night of May 3 after their ride from Albuquerque that day, and will return to ABQ the following day. The Society provides Glorieta accommodations, evening entertainment, and all support services both days to participants. All kinds of prizes will be awarded based on pledges turned in after the tour.

For less experienced bicyclists who'd like to try a shorter trip, the MS Society is also sponsoring a "Pig Out and Pedal" ride from Albuquerque to Coronado Monument on April 27. You'll leave the Albuquerque Museum around noon that day and stop for tasting/touring visits at some local wineries on the way to the Monument. After exploring the Monument, it's back to the University of Albuquerque for a free all-you-can-eat feast. Prizes for this tour, too. Advance registration required for both tours. Call the MS Society, 888-4948, for more info.

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**Still More Bowling** — Mark your calendar now for more SANDOE tournaments:

•Best Ball	Holiday Bowl	Feb. 15-16
•4-Game No Tap	Fiesta Lanes	March 15-16
•3-Game Scotch Doubles	Fiesta Lanes	April 12-13



# LAB NEWS

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## Death



Cheryl Vigil of Secretarial Services 22-2 died suddenly Jan. 13. She was 28.

She had worked at the Labs since September 1983.

Survivors include her husband and a son.

## Sympathy

To Theresa and Michael (2346) Leighton on the death of their infant son, David, in Albuquerque Jan. 8.

To Rosalie Crawford (1) on the death of her mother-in-law in Albuquerque Jan. 18.

To Mary Wilson (5161) on the recent death of her mother in New Hampshire.



# New Systems Automate Explosive Test Facility

Two new digital fire-control systems and high-speed data acquisition networks were recently installed in the Area 8 Explosive Test Facility, which is part of Pat Gildea's Environmental Test Division 8183. "These new systems mean that our engineers who work with explosives now have the most efficient explosive test control and data collection capabilities in the country," says Jim Mitchell (8183), coordinator of the facility.

The computer-controlled high-speed data acquisition systems provide test repeatability, data reduction capability, and data output (plots) within minutes of the test. Data reduction and data output used to require at least two to four weeks.

The test facility includes the recently renovated fire control room, which houses the data acquisition instrumentation and fire control hardware. It supports three isolated and independent explosive test chambers, along with a high-speed spinner. The two large test chambers have a one-pound explosive limit; a third chamber is limited to 35 grams. Between the two large chambers is a narrow room containing high-speed streaking and framing cameras used on some of the tests.

The new fire control system, which took more than three years to plan and install, includes two color graphics monitors with touch screen control. The operator uses the touch screen capability to set up, control, and monitor all aspects of an explosive test — safety, test countdown, timed event relays, and interlocks. Greg Hawley (8478) did much of the initial design of the new system.

The new safety features show up on the screen as green and red lights, depicting the controlled access points; the lights show whether the interlocks are satisfied. "If we have to abort a test countdown before we fire the explosive component, the system automatically logs as much information as possible about the status of the test," says Jim. "So the operator can go back and review the pretest procedures for possible problems." The system uses a voice synthesizer to provide countdown and warning messages over the intercom. The fire controller also operates a data logger that, for system stability, monitors the intake and exhaust temperatures of the instrumentation racks and each rack's three-phase power requirements.

Currently, the facility is using a high-speed data acquisition system as the primary means of data gathering. "We're now integrating new high-speed digitizers into the system," Jim notes. These will allow a real-time recording window of 2.5 milliseconds.

"And *that's* like all day long to us in the explosive testing world," Jim continues. "It lets us trigger a device and then record for a long period of time without having to worry about providing critical timing triggers to capture the data."

Jim notes that both instrumentation systems are isolated from building ground: "That gives us the best possible single point ground with today's technology." The ground resistance readings have been very favorable, which reduces the facility's electrical noise problems. In addition, the



TRYING OUT the new touch screen firing control system are (from left) John Rosenow, Bernie Bernal, Jim Mitchell, and Cory Ottesen (all 8183).

signal cables and conduits, which run from the instrumentation racks to the shot tank area, have been isolated. To monitor the integrity of the ground system, special ground fault monitors have been built. These monitors will also assist in keeping the power to the instrumentation system isolated and safe.

Six years ago the test facility was using more than 30 analog oscilloscopes with cameras to record all of its explosive test data. The scopes and cameras needed constant adjustment, monitoring, and film replacement on a daily basis, costing the operator two to three hours a day of valuable time. Now that the data acquisition system has been automated, the computer handles all of the instrument setup, data acquisition, data storage, and data processing

— and does it all within minutes.

The automation also greatly increases test and data repeatability. The operator initializes the instruments at the beginning of the test, and from then on the data acquisition system resets itself, acquires data, scales it, and prints the plots. After the test engineer has been given the plots from the test, a duplicate is archived on nine-track tape, so the engineer can do more detailed reduction at a later date.

Working with Jim on the renovation and upgrade of the facility was Cory Ottesen (8183), who developed the fire control software. Bernie Bernal and John Rosenow (also 8183), who operate the facility, supported hardware fabrication and installation.



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### Take Note

Peter Mattern (8350), Patricia Smith, and Jack Bishop (both 8265) were recently notified that their brochure, "Visiting Program at the Combustion Research Facility," received the Award of Excellence from the Northern California Region Technical Publications Competition of the Society for Technical Communication. They will be

recognized at a banquet Feb. 22 in Millbrae. The entry will also be entered in the society's international competition.

### Congratulations

Dotty and Andy (8184) Cardiel, a son, Alexander Raymond, Dec. 29.

Linda and Ken (8176) Nunes, a daughter, Alyssa Rae, Dec. 5.



MAKING HIS FINAL VISIT to Sandia Livermore on Jan. 10 was President George Dacey (right). Here he is discussing the safety system in the control room of the Tritium Research Laboratory with 8000 VP Dick Claassen. George also delivered a farewell message to employees during his visit.



# Supervisory Appointments

DAVID SMALLWOOD (DMTS) to supervisor of Modal and Structural Mechanics Division 7544, effective Jan. 16.

David joined the Labs as an MTS in the Vibration and Acoustics Division in May 1967. He's been with the same group "through a variety of name changes and supervisors" ever since. David was named a Distinguished Member of the Technical Staff (DMTS) last year. Before he came to Sandia, he worked at Bell Labs in New Jersey for five years — four at Murray Hill and one at Holmdel.

David has a BS in ME from New Mexico State University and an MS in the same field from New York University. He is a Fellow in the Institute of Environmental Sciences.

He spends some of his spare time camping and playing tennis, and until recently was a Scoutmaster. He and his wife Camille have four children and live in the NE Heights.



DAVID SMALLWOOD (DMTS, 7544)

ED MARTINEZ to supervisor of Plating and Coating Section 7473-3, effective Dec. 16.

Ed was a messenger in Mail Services when he joined Sandia in December 1963. He also worked in the print shop before transferring to the organization he now supervises.

He received a TI certificate (materials) through Sandia's Technical Institute Equivalency Program in the early 1970s, and has a BS in physical science from the University of Albuquerque.

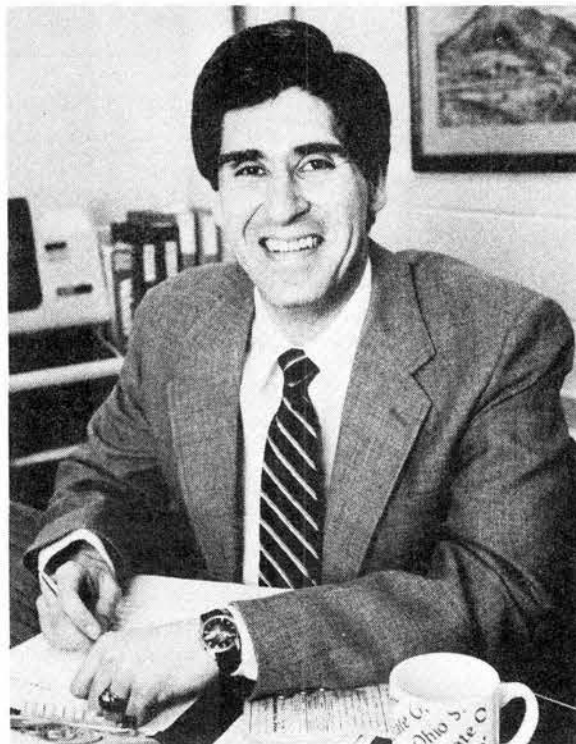
Ed likes to hunt and fish. He lives in the NE Heights.

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SALLY LANDENBERGER to supervisor of Technical Library Processes Division 3141, effective Dec. 16.

Sally was assigned to the Technical Library Department as a library resource analyst when she joined Sandia in February 1983. She was named supervisor of the Books/Periodicals Processing Section in September that year, and transferred to the Reports Section last year. She worked as a supervisor, technical services, at university libraries (Wayne State and Michigan State) for about ten years before coming to Sandia.

She has a BA in history from Pennsylvania State University and an MS in library science from Wayne State. She is a member



JAY SANCHEZ (3533)

of the American Library Association.

In her spare time Sally likes to camp, hike, and explore her relatively new Southwest environs. She and her husband Paul have a 6-year-old son and live in the NE Heights.

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JAY SANCHEZ to supervisor of Personnel and General Employment Division 3533, effective Dec. 16.

Jay joined the Labs as a job analyst in the Salary Administration Department in August 1981. Two years ago he transferred to the Labor Relations Department, where he's been until his recent promotion. Before he came to Sandia, he had jobs in recruiting, job evaluation, and employee relations at Pacific Gas & Electric Co. and Phillips Petroleum Corp.

He has a BS in psychology and economics from UNM and an MS in personnel and labor relations from Ohio State University. He taught an introductory management course for freshmen at UNM in 1981-82, and currently is professor of personnel and labor relations in the graduate program at the local campus of Webster University. He is a member of the Industrial Relations Research Association and the American Compensation Association.

Jay's spare time activities include skiing (downhill and x-country), running, and fishing. He and his wife April have a son and live in the NE Heights.



SALLY LANDENBERGER (3141) and ED MARTINEZ (7473-3)



Here are some current opportunities for employees, retirees, and family members. If you would like more information, call Karen Shane (4-3268).

**NEW MEXICO REPERTORY THEATRE** has an opportunity for anyone (perhaps high school/college students) to usher (and attend free of charge) five KiMo Theatre productions. Ushers are requested to be at the theatre one hour before curtain (8 p.m. weekday evenings or 2 p.m. Saturdays and Sundays).

**RIO GRANDE ZOO'S** docent program will offer an introductory coffee for volunteers who may be interested in giving weekend tours. Training will begin with the coffee at 10 a.m. on Saturday, Feb. 1 in the zoo's red barn.

**LOVELACE MEDICAL CENTER** needs volunteers to help weekdays with its admitting and X-ray services and its gift shop.

## Congratulations

Frank Bouchier (1254) and Nance Stults, married in Albuquerque, Dec. 28.

Gayle and Tim (7476) Gardner, a daughter, Megan Elizabeth, Dec. 28.

Margaret and Paul (7485) Cunningham, a son, Nathan, Jan. 10.

Nancy and Doug (3180) Barr, twin daughters, Lindsay Jacqueline and Alexandra Michelle, Jan. 14.

Bess Campbell-Domme (1821) and Curtis Domme (7862), a son, Gregory Allen, Jan. 16.

Peggy Maddox (7520) and Jim Baremore (5210), married in Albuquerque, Jan. 18.

## CU Annual Meetings Set

Annual meetings, which will feature the results of the Board of Directors election, for the Sandia Laboratory Federal Credit Union are set for 5 p.m. on Feb. 13 at the Coronado Club in Albuquerque and 4:15 p.m. on Feb. 26 at the Elks Club in Livermore. All CU members are invited to attend either one.



# Sandia: A Top-Notch Lab

*Editor's Note: This "State of the Labs" message marks George Dacey's last day as Sandia president and serves to introduce his successor, Irwin Welber. George's fourth annual message — he calls this one his "sunset salvo" — is a condensation of interviews with George, Irwin, and Tom Cook, Executive Vice-President 20, conducted by members of Public Affairs and Employee Communications Department 3160. Complementing the "State of the Labs" articles is a "State of the Budget" interview with Paul Stanford, Controller 100, and Ralph Bonner, Manager of Budget and Financial Planning Department 140; see Page Eight.*

LN: George, what do you consider the high point of your four-and-a-half years as Sandia's president?

GD: That's a difficult question. There have been many high points — in fact, I've been on an almost continuous high since I got here. But if you're asking "What was the one moment that gave me the greatest pleasure?" it was last summer when the Blue Ribbon Task Force [on Nuclear Weapons R&D and Production] came out with a report that completely supported the management style and the results produced by Sandia and the other national laboratories over the past several years.

The report shows that the DOE system can really produce reliable hardware and move it into the field — it does what it's supposed to do.

LN: Why is it that the DOE has such a good track record?

GD: It's at least partly because of the nuclear weapon complex's vertically integrated operating system — we don't design

**We can compete with anybody in hiring good people from anywhere. —Cook**

something and then go out and get competitive bids from whoever is going to build it. We know who is going to build everything Sandia and the other weapon labs design. We work with the production complex all during development. The production contractors take their job seriously because they're going to have to live with whatever they do. A lot of people think that system has some real virtues that don't exist in the DoD system.

IW: I think we and the DOE have been so effective because we are concerned about the placement of these weapons in a peaceful society. There's a nice balance between the readiness of these weapons to be used at a moment's notice, which is a DoD concern, and embedding them in a peaceful society in such a way that both weapons and society are safe, which is a DOE concern.

TC: It's also true that the government provides Sandia with a lot of good facilities. And AT&T provides us with a good administrative pattern — competitive salaries and policies and people. We can compete with anybody in hiring good people from anywhere. Not many of the DoD laboratories



ATOP BLDG. 823: incoming president Irwin Welber and outgoing president George Dacey. George's tenure was marked by a revived building program and the upgrading of older facilities.

are in that position. In fact, it's quite the opposite.

LN: What was the rationale behind the Task Force's charter?

IW: Some of the originators of the Task Force apparently felt that, "Since the DoD is spending the money [for nuclear weapons], shouldn't it have the right to manage the program?"

TC: But the Task Force did, in fact, turn around — it ended by endorsing the current system and asking why the DoD doesn't follow the same pattern.

GD: Yes, the Task Force decided to leave the nuclear weapon complex as is. The report documented the complex as being one of the world's outstanding examples of a technologically capable organization that gets things done, and recommended leaving it with the DOE, continuing its major nuclear weapons mission, but giving it the right to establish footholds in the advanced conventional munitions arena, and we're doing that.

At any rate, the Task Force came out with what seemed to me a complete vote of confidence in the system and, in particular, in the people who were running the programs. That was most gratifying, certainly a high point in my career.

IW: I would like to mention another kind of high point of George's tenure. That's the respect that the key players in Washington — DOE leaders, senators, congressmen,

**Sandia's management style is rare enough among Washington contractors that we occupy, if not a unique, at least a very special kind of position. —Dacey**

key committee people — have for George himself and for what he has done at Sandia. That's something he should be proud of, and I am certainly pleased to have seen it when he introduced me around Washington.

LN: How do you feel about that, George? How are you received in Washington?

GD: Well, it depends on by whom — I

introduced Irwin only to people who like me. But I think Sandia in general and most of us, our managers in particular, are well

**Our management style emphasizes results and honest reporting—calling the shots as we see them—and a can-do attitude. —Dacey**

received. Sandia is respected, and I believe that our management style — I don't mean my style personally, but Sandia's management style — is rare enough among Washington contractors that we occupy, if not a unique, at least a very special kind of position.

LN: How would you characterize that management style?

GD: It's one that emphasizes results and honest reporting — calling the shots as we see them — and a can-do attitude, all of those things.

LN: Let's turn to the other end of the spectrum. What's the low point of your tenure?

GD: Well, I guess the lowest point was during the darkest days of the radiation cases against us. We were, as you know, being sued for our involvement in nuclear testing back in the 50s by hundreds, even thousands, of people — Marshall Islanders, ex-servicemen, and others. The suit suggested some sort of malfeasance on the part of Sandia, for one, and could have questioned our role in testing nuclear weapons. Fortunately, Congress set aside these concerns by legislation, and I think the problem is now behind us. However, at the time it was a very worrisome thing.

LN: Is there anything worrying you about Sandia as you leave?

GD: If you're asking me, "What is the one feature of the Sandia ethos most in need of improvement?" it's a tendency toward intellectual arrogance. That is not productive. If all of us — and I include myself in this — could learn to be more supportive of our colleagues, in DOE for example, and try to be more understanding of the pressures

(Continued on Page Two)



# The Budget, the Deficit, and the Labs

*LN: The deficit is obviously looming over our personal as well as professional lives at Sandia. If some critic said that one of the major ways to cut the deficit is to cut the Labs, how would you respond?*

GD: That's hardly a new question — the critics have been saying that for a long time even without the deficit. However, I think one has to look at any cutback in expenditures from a practical economic standpoint: what is it that you're paying for? what are you getting for your money? and what are your needs? It's clear that, for the foreseeable future, this nation must have a strong defense program whether there's a deficit or not. Peace in this world, especially in the nuclear age, is beyond price and must be maintained; the deterrent posture must be maintained, and I'm convinced it will be maintained whether we have deficits or not. I think the need for a strong military program is completely recognized.

That's not to say that you can't save money. You might well ask "Will there be some cost-saving measures?" I think it's clear that there will be and that the total defense industry will be affected to some extent. There will be cutbacks.

Now, where will those cutbacks occur? Well, some of them may occur in Sandia, but, broadly speaking, I think it

**Peace in this world, especially in the nuclear age, is beyond price and must be maintained. —Dacey**

will be true that marginal programs — programs of lesser utility, the lower end of the priority list, programs of lesser capability, competence, results — will be the first to go. Therefore, to the extent that we are working on programs that are of higher priorities and of greater capabilities and performance, those are more likely to be the programs that'll be

preserved in any total cutback.

*LN: In a crunch, could we not simply accept more reimbursable work?*

GD: There are lots of people who say they want us to do things, but whether they now have or will in the future have the money to pay for them is another issue. It's very unsettled right now. It's not clear at all whether there will be major cuts in entitlements, or whether there will be massive cuts in defense, or whether there will be any major cuts at all. So, in that climate I don't think any of us knows exactly where the axe is going to fall.

*LN: If that axe falls in our direction, what belt-tightening measures might we take?*

GD: It has always been our intention, and it's no secret, that we use outside contracting, outside suppliers, outside drafting, and so on, to provide flexibility and that, if we have strong financial pressures, we will certainly try to maintain our internal capabilities first. Only after the problem got very, very extreme would we consider trying to cut back internally. That's been our understood policy forever.

*LN: How might the current austerity push affect salaries?*

GD: It is obviously management's intention to run the best technical laboratory that one can. That's the job as I see it. In order to do that, one must have the best people that one can possibly acquire and retain, and that means in turn that one must pay salaries that are competitive and fair. That in turn means that we will continue to monitor the marketplace very carefully and assure that we pay our people what they deserve and could command in the general marketplace. It is our firm intention to relate our internal salaries to a fair market evaluation of the skills of the people we want and

need and must hold.

IW: As we do this, we must justify our recommendations to the DOE, and we must also examine what Bell Laboratories is doing because the Bell Labs people look to the same kind of market that we do for comparing salary

**We must maintain a top-notch staff here, and we must reward them properly. —Welber**

structure of our technical and administrative population. We intend to maintain a competitive posture with the people we have to compete with because, if we don't, we'll suffer the consequences. We must maintain a top-notch staff here, and I think we must reward them properly.

*LN: With AT&T suffering some financial difficulties these days, does that affect Sandia salaries directly or indirectly?*

IW: Only indirectly. If AT&T for any reason decides that it cannot maintain a salary structure for its technical population because of financial reverses, we would have to examine what that would mean to Sandia. In the end, we must report whatever we do to the DOE.

GD: Our DOE contract calls upon Sandia to follow generally the practices of the AT&T "with such variations as may be due to local conditions," I believe the phrase is. If there is a local condition that makes it sensible to depart from those practices, then, of course, we would depart.

I want to emphasize, however, that AT&T finds itself in exactly the same position as we do. It must have for Bell Laboratories the same kind of excellent staff that we want to hold. So it's not going to be possible for AT&T to somehow get its jobs done without paying appropriately market-driven wages.

they are under, and help them with discharging their duties, then we could be even better than we are now.

*LN: In terms of administration, what do you see as the dominant trend during your tenure?*

GD: Well, I think that there has been a really substantial improvement in the way in which we pick and choose the things that we will do and the things that we will not do, and in the interrelationships among various programs. When I came here, our reimbursables (including a very large energy program) were distributed across a number of areas and didn't look as if they were related to each other. They were all related to Sandia's capabilities and had the synergies that we've talked about so many times, but they weren't necessarily part of an interrelated package.

Now, what we've tried to do is to establish an interlocking committee structure for reimbursables, the NSAC [National Security Advisory Committee] being the centerpiece, that looks at all of Sandia's reimbursable programs as related to each other and, in particular, looks at the base they provide for future growth and future possibilities as the needs of the nation change. I have been

very pleased by the way in which all of our budget program advisory committees have done their work. I think that our present committee structure has more management control, more rationality, and more thought in terms of what the future effects of these programs are going to be than was

**Sandia's preeminence as a national lab in engineering is in no small measure due to the full-spectrum nature of our mission. —Dacey**

true several years ago.

*LN: What's the rationale underlying NSAC's choice of new programs?*

GD: One of the points we made very strongly during the Blue Ribbon Task Force investigations was that Sandia's preeminence — I think it's not presumptive to use that word — as a national lab in engineering is in no small measure due to the full-spectrum nature of our mission: nuclear weapon research, exploratory development, final development, development for manufacture, quality assurance, care and feeding of the stockpile, retirement. All of those elements, except the ac-

tual physical manufacture itself, have been lodged in Sandia under the statutory requirement that only the U.S. government can do those things, and we've been given that responsibility.

In reimbursable work, that statutory underpinning does not exist. So we might be tempted to accept reimbursables that have only one element — a piece of research or a piece of something else. To the extent, then, that it's possible for us to at least approximate the same missions in non-nuclear work, that's what we'll look for, that's what NSAC will deliver — programs that are full spectrum.

*LN: Are there other planning activities that deserve credit here?*

GD: I think we've improved our future planning significantly. It too is now more organized. Now, obviously, Sandia didn't just happen. All of previous management has been planning and, I think, planning very well — look around you: you'll find an excellent organization with good buildings, good facilities, good people, and good programs. Obviously, that's the result of prior planning.

On the other hand, the planning was



somewhat undocumented. Over the last several years, we've tried to formalize the planning process a bit, to introduce just a little more discipline into it, a little more record keeping. The recent Small Staff meetings that we've called retreats (for reasons I can't tell you — we could better call them "advances") have given me a feeling that we are more consciously considering our future options and that the plans we are making are somewhat more specific than those we had in the past.

LN: How does that kind of information, plans for the future, get shared with the Sandia community?

GD: Well, plans for the future in specific detail, of course, are not shared because plans are what they are — plans — and there's an old saying that "Man proposes, God disposes." The planning that I'm speaking about is top management planning for alternative futures. The sharing takes place when it becomes real, when the plans materialize in some sense or another.

### A Look at Sandia's Weapon Programs

LN: Let's look at weapon programs in Phase 3. How's the MX [Peacekeeper] coming along?

TC: We're nearly halfway through the full missile system flight test program on the MX and all has gone well. We'll complete the development on schedule this spring.

LN: We said last year that the W88, the Trident II missile, was our most challenging task in terms of the solid state technology it carries, for example, the compensating fuze [which senses inaccuracies in targeting and adjusts the fuzing to compensate]. Have we run into any unexpected problems with that program?

TC: We are rapidly finishing up all the design issues, and the program's going well. In fact, last fall we delivered to the Navy the first complete arming, fuzing and firing system for use in the R&D flight test program; the first flight test is set for early next year.

LN: Has the program moved forward pretty much on schedule?

TC: Right on schedule. We've had the usual development problems, which Sandia really turned to and fixed, so we are in good shape. The Navy is very sensitive about maintaining schedule — and cost, I might add — and so are we. In spite of the press coverage about overruns on submarines and the like, we're all — Lockheed [the prime contractor for Trident], the Special Projects Office of the Navy, and ourselves — doing a good job, both on schedule and cost. Trident, of course, gets high priority treatment at the national level as well as within Sandia.

LN: We said last year that the ASW [anti-submarine weapon], because it combines features of a warhead and a bomb, would be a challenging development effort. Is it moving ahead satisfactorily?

TC: We're expending a lot of effort on it, and it's going well.

LN: Is the W82 [six-inch nuclear artillery shell] still our most unstable major program?

GD: I'm afraid so. It's been sputtering along for some time, and it's now showing signs of life again. Congress did appropriate

\$50 million for its production, so we have a revised target date for completing the W82. Technologically it's a very challenging program. That's a big effort in Livermore.

LN: What are the particular challenges — packaging, miniaturization, rifling?

TC: First of all, six inches is awfully small. It also has to withstand tremendously high g-levels and vibration levels as it rifles out the barrel. So the challenge is a combination of the size and the very extreme environments. But again, we've worked in those areas for so long that we think we have all that in hand.

LN: Do we have any weapon programs that are in trouble?

GD: The W81 [Fleet Surface Defense warhead] program has been on again/off again for many years. But now Congress has decided not to spend any more money on it, so it looks as if the W81 might disappear. It's one of our smaller programs and we've seen the decision coming, so I don't expect any problems, whether its demise is temporary or permanent.

LN: Can you predict what new weapon programs we might see in the future?

GD: I certainly can't, and, at this point, I doubt anyone can. The future of the nuclear weapons programs might be im-

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### We as a country are not going to diminish our capability to protect the national interests. —Welber

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pacted in a major way by whatever arms control agreements are reached in the future. It all depends on what the country commits itself to.

IW: It's clear, though, that we as a country are not going to diminish our capability to protect the national interests. If we decide, as a matter of national policy, to reduce our activities in nuclear weapons, there may be a concomitant increase in advanced conventional munitions. In other words, the nature of how we protect ourselves may change in time so that we must be ever alert to turning our activities to where the country needs them. That could be treaty verification, or advanced conventional munitions, or energy...

LN: Do you see a major role for us to play in any or all of those?

IW: Absolutely.

LN: Last year we said that the number of weapons in the stockpile was not growing very much and the yield is actually going down. Does that trend still hold?

TC: Those trends are still true — the yield is decreasing and the numbers are not increasing.

LN: Sandia has traditional responsibilities in command/control and safety. How do you feel we've done?

GD: Safety has always been our top priority. It still is, and as the years go by we do a better job of it.

LN: Any improvements in command/control?

GD: Let's just say we're making it more and more difficult for an adversary to use a captured weapon.

### New Trends in Weapons

LN: What trends have you seen in



GEORGE DACEY, Vice-President Research, 1961-63.

weapons over your years here, George?

GD: The dominant trend, not only during these past five years but almost a continuous trend — I saw it during my stint here as a vice-president of research in the early 60s — is that of higher sophistication, which involves higher accuracy and lower yield, and more specific technical features, which lead to the maximization of a particular mission capability.

One element of that is the trend toward the wider use of microelectronics, radiation-hardened microelectronics in particular, for doing more sophisticated things within the weapon than has been possible in the past. So, that trend toward greater sophistication, greater use of intelligence and computation, is one that has been accelerating in recent years and will continue to do so.

Of course, along with that is a greater capability in weapon performance — safety, security, flexibility without sacrificing reliability, and all of those concerns that, with a weapon as powerful as the nuclear weapon, have to be paramount. I think we are becoming more sophisticated there. There are many more safeguards feasible today than there were some years ago. That trend also, I think, will continue.

LN: We said a moment ago that the yields of our weapons are spiraling down. Will we ever, thanks to smarter weapons and better accuracy, get to sub-nuclear yields?

GD: There's been a lot of confusion about whether or not a conventional weapon can replace a nuclear weapon. It's clear that for certain kinds of targets, let's say one person, if you had a bullet that hit the person in a lethal spot, then you wouldn't need a nuclear weapon. That would be overkill *par excellence*.

On the other hand, it is a fact of nature that the most efficient explosive in terms of yield per unit weight that exists on this planet is the nuclear explosive. Therefore, to assume that you can, by mere accuracy, do all kinds of damage equivalently — at equivalent cost — with conventional explosives is absurd. You can have a factor of a million in terms of the explosive efficiency. Therefore, for certain kinds of targets, there is no way that increased accuracy is going to supplant nuclear weapons. That's also clear.



The confusion arises because with increased accuracy there are certain kinds of targets that could have been destroyed in the past only with a nuclear weapon — because of the uncertainty of where the thing would explode — and, of course, with immense collateral damage in the bargain. Some of those targets can, with increased accuracy, be killed with conventional weapons.

So, to ask "What is the role of advanced conventional munitions? What kinds of missions can they best accomplish? And what are the remaining roles for nuclear weapons?" makes sense. But to assume that you can just sort of get rid of nuclear weapons is, I think, just wishful thinking, whistling in the dark.

LN: Can you provide some specific examples of the kinds of targets that might be attacked by conventional weapons?

GD: One such target might well be tanks. There are two ways to kill a large assemblage of tanks. One is with a weapon that eliminates everything in the whole area, including the tanks. The other is with very intelligent submunitions, each directed to kill a tank. Those submunitions, if they hit the tank, don't need to be nuclear. So, for a dispersed set of targets, it's conceivable that advanced conventional munitions could replace nuclear munitions.

On the other hand, if you can't see the tank formation, or if you have only a general idea of where the tanks are, or if you are trying to blow up an enormous concrete structure — a missile silo or a buried command post, for example — you're going to need a very powerful explosive.

LN: What do you mean by "submunitions"?

GD: There are now some advanced conventional munitions in which a carrier sent to the target region dispenses a set of smaller "seeking" munitions. Each one finds its own target.

LN: So are we planning any major effort in ACMs?

TC: Not a major effort, at this point anyway. As we said earlier, we are merely establishing a foothold in conventional munitions. We are focusing that effort on ACM systems that use and build upon the technology base we have developed for nuclear weapons. But our nuclear weapons program always comes first.

### SWERVE: 'Really a Milestone'

LN: Let's talk now about intelligence

within the weapons themselves. Are we making progress there?

GD: Yes, and the SWERVE [Sandia Winged Energetic Reentry Vehicle Experiment] program is, I think, a good case in point. This past year has been an exciting one for SWERVE. The organizations involved staged an enormously successful flight in which the maneuvering capabilities of SWERVE were demonstrated beyond anyone's wildest hopes. The SANDAC [SANDia Airborne Computer] and the radar aboard operated very well, and so a rather sophisticated maneuvering vehicle technology has been demonstrated.

It's a prime example of an intelligent weapon — a vehicle that has advanced sensors that bring information into it, and that can maneuver and react to that information in new ways.

The SWERVE flight was really a milestone this year, no question about it.

LN: George, you said last year that you thought the day of the gravity bomb was about finished. Aren't we now suggesting that SWERVE-type weapons add a new dimension to nuclear weapons?

GD: Well, much of the concern, I think, about ballistic missiles stems from the fact they aren't very controllable once you launch them. Now that makes them useful for certain kinds of things, but from the standpoint of control and the standpoint of a stable world, politically and militarily, that property is undesirable. So, going from ballistic weapons to intelligent, maneuverable, controllable weapons has got to be a step in the right direction. So, yes, I think the dimension of maneuverability and control is a whole new dimension.

LN: You mentioned the lack of controllability in ballistic missiles. So is SWERVE the next step?

TC: It's going to be some form of guided, maneuvering reentry vehicle for our missiles. And SWERVE's in tune with that. My own view of SWERVE is that it's a great technological Maypole that we at Sandia are using as a tool for developing these technologies.

LN: Technological Maypole?

TC: It's a focal point for learning what the problems are and what we can do to solve them. A lot of people are very excited about it. SWERVE's a highly sophisticated flying machine with the kind of technical challenges we need around the Labs to stimulate thinking. We're developing technologies around it, using it as a focus.

LN: Are there people or groups that we

ought to mention as fathers, if you will, of SWERVE technologies?

TC: It's hard because the effort deliberately permeates the Labs, but Bob Clem's group [1600] was the ringleader in pulling the SWERVE program together this time. [Departments include 1650, 1620, 1630, 1520, 2330, 2340, 2540, 2850, 5140, 7130, 7170, 7480, 7520, and 7540.]

LN: Looking at the future in a more specific light, at the component level and subsystem level, do you see any bright new ideas coming along?

TC: One is that we are incorporating more electro-optical devices and interconnections in our systems — as is everyone else in the outside world, of course.

LN: Are we talking about fibers or lasers?

TC: Both. But electro-optics — replacing wires with fibers that interconnect optical transmitters and receivers — looks especially promising.

IW: The other big thing is probably software. The major part of our past efforts has not been in software, but I think there's going to be a gradual increase in that activity as we design more sophisticated weapons and try to install in them the capability to detect their environment — do smart things.

LN: If you don't have hard wires connecting everything, does that increase reliability, safety?

TC: Both. You reduce problems from electrical interference, et cetera. In fact, in a major way such problems are just gone — so that improves reliability. And it offers various new opportunities for safety features — it's easier to block off a light path than to have a high-voltage switch.

IW: And intrusion becomes more difficult if you have fiber optics, properly designed, as opposed to copper.

### A Look Back at 1985

LN: What kind of year did we have in FY85?

GD: Well, it's difficult to answer that question every year by saying, as I'm inclined to do, that it was the best year ever, but it certainly was an excellent year. We've already reviewed some of our specific accomplishments, so I think that should be clear. It's a year in which our building program continued to flourish — which, in view of the fiscal strictures, is particularly pleasing. On almost every front, I think, it has been a particularly good year.

LN: Any worrisome signs on the horizon?

GD: One is the continuing decline in the energy programs, which is certainly of some concern. 1985 was not the year of turnaround in national perception as to what our long-term energy research level ought to be. Whether we will see that turnaround in '86, I don't know; I doubt it.

IW: I guess, George, we could have mentioned that continuing decline as one of your greatest disappointments.

GD: Yes, I think it is. It's disappointing because it seems obvious to many of us that unless the nation wants to depend increasingly and indefinitely on foreign sources of oil, then there is an energy problem. If you

(Continued "State of Labs" Page Five)

GEORGE and VP Dick Bice were among the Sandia executives who greeted President Kennedy during his visit here in 1962.







## Technical Accomplishments 1985

Continuing a LAB NEWS feature begun five years ago, *Technical Accomplishments 1985* sums up what we, Sandia National Laboratories, consider our principal technical achievements for the year just past.

The work summarized here has been submitted by technical organizations in Albuquerque, Livermore, and Tonopah. No attempt has been made to rank items. The responsible department is given in parentheses after each item.

### Weapon Systems

- The SWERVE III maneuvering reentry vehicle flight test occurred in April. The vehicle was launched from the Kauai Test Facility on a Stryi IX booster and reentered near Johnston Island; vehicle performance was excellent. Sandia's inertial measuring system (RIMS) and airborne computer (SANDAC) performed flawlessly during the test. The RIMS/SANDAC combination performed all navigation, guidance, and control functions of the missile booster and the SWERVE vehicle from launch through reentry. The flight was the first step in the development of a long-range smart weapon system that can detect and attack targets with high accuracy. (1650/2330)

- Using the SCABBARD combat simulation model, we completed a force movement analysis with the Combined Arms Operations Research Activity (CAORA) at Fort Leavenworth, Kansas. The movements of several U.S. and Soviet divisions were simulated with a resolution down to individual vehicles. Time windows for major defensive maneuvers were examined for their relevance to U.S. Army tactics and doctrine consistent with the Airland Battle Study. We also

examined the deployment of sensors designed to give defensive forces a clear understanding of Soviet operations. (8470)

- As a part of the Stockpile Improvement Program, modern nuclear safety features were designed into the W31 firing set for Nike Hercules. The development program was highly successful, completing all preproduction activities on schedule and sixty-day lead time for production. (2360)

- The formal Phase 2A process on the Sea Lance Anti-Submarine (ASW) nuclear depth bomb (NDB) is nearing completion. This process of defining the baseline NDB design for development involves trading off design parameters with respect to requirements, performance, and cost. A joint DoD/DOE Phase 2A report is in final review within the Navy. This report represents the current baseline NDB design and the changes that have evolved during the Phase 2A Design Definition and Cost Study. In support of NDB projects, a water entry test series was conducted off the Pacific coast. The tests, involving aircraft drops of instrumented test units over a range of impact angles and velocities, verified the NDB's structural integrity and underwater



LAUNCH OF A PEACEKEEPER missile from Vandenberg AFB. In the nose section are W87 development warheads carrying Sandia components and a specially developed telemetry system in place of the physics package.

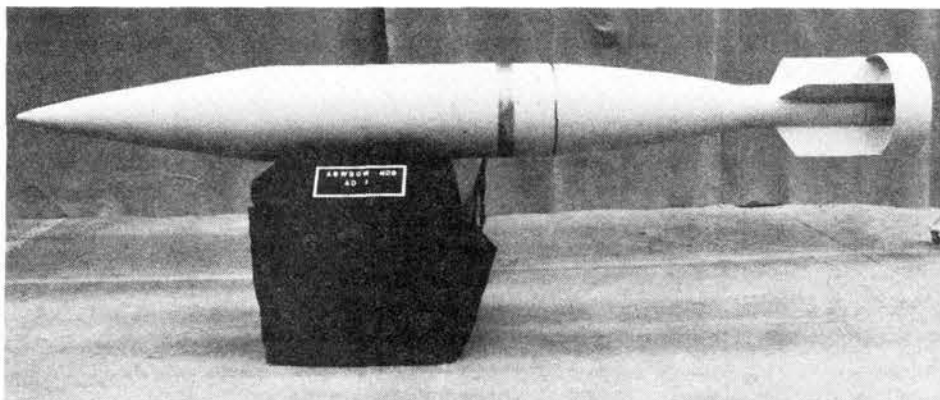
stability and provided valuable design information. (5170)

- We demonstrated tracking and pointing dynamic performance on a single degree of freedom gimbal, which is directly applicable to a two degree of freedom tracking system. This hardware is being used for additional tracking and pointing experiments, including a laboratory test of a passive infrared tracking system and a beam stabilization control system for a Los Alamos National Laboratory experiment. (8430)

- The B61-7 bomb assumed full production status during the year. The B61-7, a major system for the Air Force Strategic Air Command (SAC) inventory, exhibits many new features, including the incorporation of Insensitive High Explosive (IHE), enhanced electrical safety, a new Permissive Action Link (PAL), backup fuzing, and command disablement. Earlier in the year, the final "proof" series of development tests was completed successfully with a Design Demonstration Test (DDT). The DDT unit, employing War Reserve representative hardware, was delivered in the laydown mode from a high speed aircraft onto a concrete target; the weapon functioned as planned. (5110)

- The W80 warhead entered production in the early 1980s for the W80-1 in the Air Force's Air Launched Cruise Missile (ALCM) and the W80-0 in the Navy's Sea Launched Cruise Missile (SLCM). During 1985, captive-carry flight tests resulted in an unlimited authorization for usage of the W80-1/ALCM by the Strategic Air Command on the pylon of the B52-H aircraft. For the W80-0, new launch platform compatibility tests were conducted in support of submarine and surface ship vertical launching system development. Also, tests of the shipboard "Hazards of Electromagnetic Radiation to Ordnance" (HERO) were conducted. (5110)

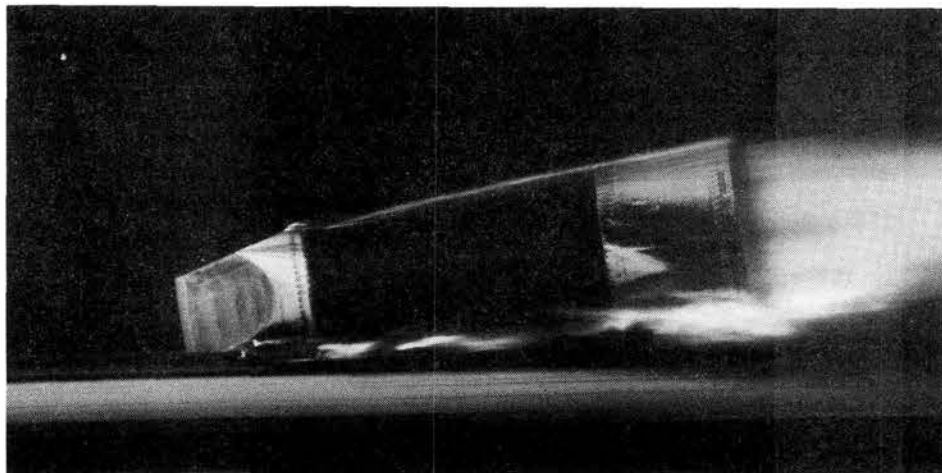
- We are building computational capabilities to model plumes from liquid and solid boosters. For solid boosters we modeled the aluminum combustion and calculated combustion efficiencies to predict aluminum oxide particle sizes in the plume. In the central core of the plume, we computed the fully coupled gas-particle transport, nonequilibrium chemistry, and radiation. Outside the core, in the plume enhancement region, a Sandia Monte Carlo code, HAMPER, is used to predict the gas dynamics, chemistry, and radiation for flow regimes. (8240)



AIRCRAFT DROPS of instrumented test units over a range of impact angles and velocities verified the Sea Lance Anti-Submarine (ASW) nuclear depth bomb's (NDB) structural integrity.



## Testing



NEW ROCKET SLED speed record was set last year on the dual rail track. A 500-pound reverse ballistic target reached 6050 feet per second (shown here by high-speed camera).

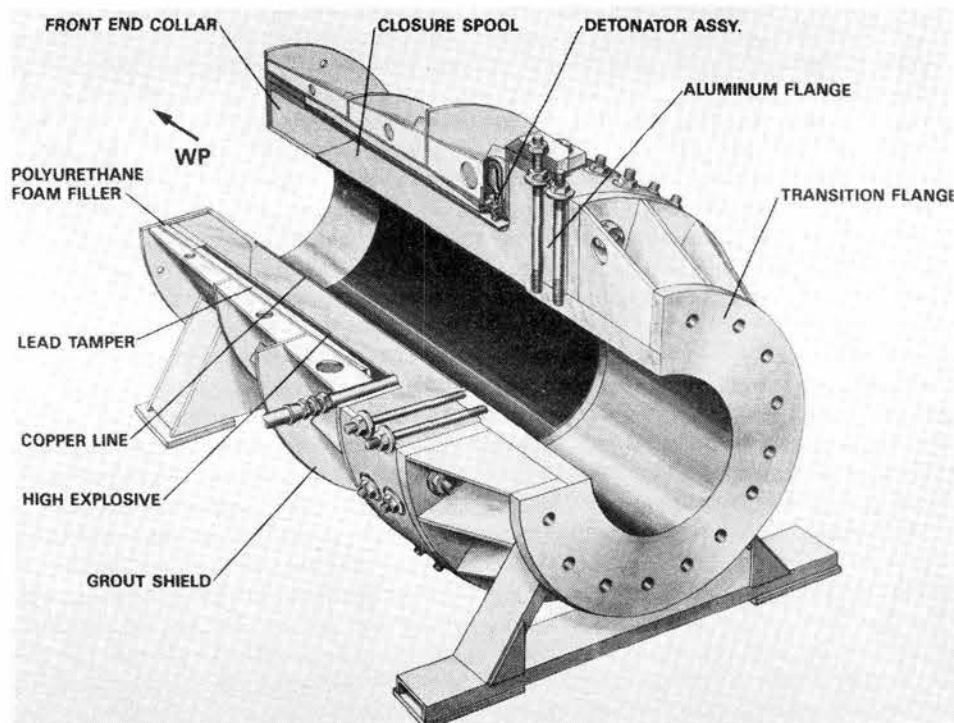
- The Stand Alone Test System (STATS) is a subsystem of all the new weapons evaluation testers used to evaluate the quality of stockpile weapons. The system provides three basic functions: (1) checking and signaling readiness of both the STATS and of the weapon to begin testing; (2) recording all the test data; and (3) analyzing the test data. Analog signals, event times, and digitized signals are recorded. The STATS is installed and used in the evaluation of 26 weapons. It has provided the capability to evaluate weapons in approximately 10 percent of the time previously required for data analysis. Its data handling reliability has been 99 percent. The characteristics and capabilities of this system are unlike any commercially available system in the number of channels that can be evaluated and the rate of sampling of each of these channels. It can be moved from one test system to another within two hours. (7260)

- We developed a Fast Acting Closure (FAC) as an essential element of a new DNA testbed concept. The FAC, which uses a chemical explosive to implode and squeeze a cylindrical section, should aid in the DNA effort to

conduct underground nuclear effects tests with faster turnaround and less cost. The FAC was fielded on two effects tests and performed well. It is now being considered for use in future testbed designs. (7110/7130)

- Four sophisticated telemetry systems were deployed on DOE reentry vehicles carried over the Pacific on Peacekeeper missiles FTM-7 through FTM-10. The launch sensing, multiple microprocessor telemetry package included wide-band analog monitoring of 13 vibration/shock channels, digital transmission of 180 data channels ranging from 30 to 15,000 samples per second, in-flight reformatting, high speed warhead event data analysis, and digital data delay with two RF data links and a radar transponder. These successful flights were characterized by high quality data transmission from pre-launch through impact with 100 percent data return from all environmental, fuzing and warhead performance monitors. (8170)

- The modal testing laboratory and the Mechanical Analysis Department together developed a new technique for the structural modeling of reentry



THE FAST ACTING CLOSURE (FAC) should aid the effort to conduct underground nuclear effects tests with faster turnaround and less cost.



THIS TWIN OTTER flying laboratory is carrying a 700-pound drop test unit on the belly and six 25-pound units on the wings.

vehicles that are composed of an aeroshell and payload. This technique uses the concept of component mode synthesis to couple a finite element model of the aeroshell to an entirely test-based modal model of the payload. We evaluated this technique with excellent results and are applying it to the Trident II program. (7540)

- A family of unclassified simulators that duplicate the electrical loads of the B61-3/4, B57, B61-7, and B83 have been or are being developed. These simulators will be used extensively during electromagnetic compatibility testing of aircraft/weapon systems and will alleviate the necessity of providing classified compatibility test units with support personnel. (5120)

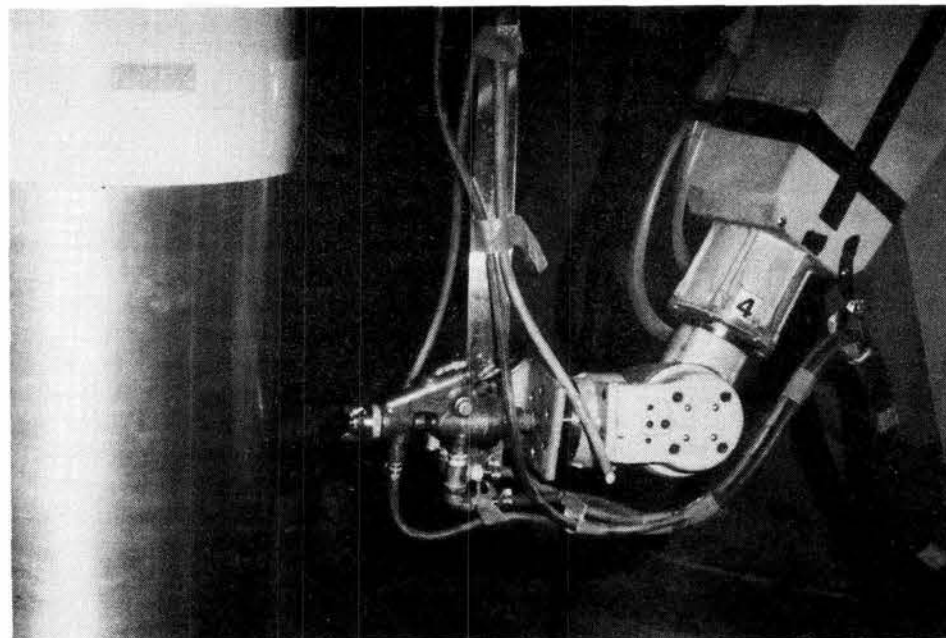
- We developed a new test facility — a Twin Otter aircraft owned by the DOE and operated by Ross Aviation for Sandia. The modified facility provides for the following kinds of tests and instrumentation: (1) telemetry recording; (2) projectile drop testing (up to 1000-pound test objects can be dropped from altitudes up to 25,000 feet and at airspeeds up to 150 knots); (3) air sampling; (4) radar navigation system testing; (5) vertical mapping or motion picture photography; and (6) oblique photography. (7130)

- A new free world rocket sled speed record was set on the Coyote Facility dual rail track. The test started from rest, covered 5000 feet, and delivered a 500-pound reverse ballistic target to impact a weapon test item at 6050 feet per second — all in under 1.6 seconds. This test impact and others were part of an ongoing program of weapon testing and sled technology development for higher R/V impact velocities. (7530)

- As part of a continuing penetration technology program, we conducted eight successful full scale tests of pointed water penetrator bodies. These test bodies have successfully entered water at velocities up to 1250 feet per second and angles as shallow as 15 degrees with respect to the water surface. A full scale rocket test conducted at the Kauai rocket launch facility featured acoustic tracking of the penetrator in three dimensions from shortly after water entry to bottom impact. (8150)

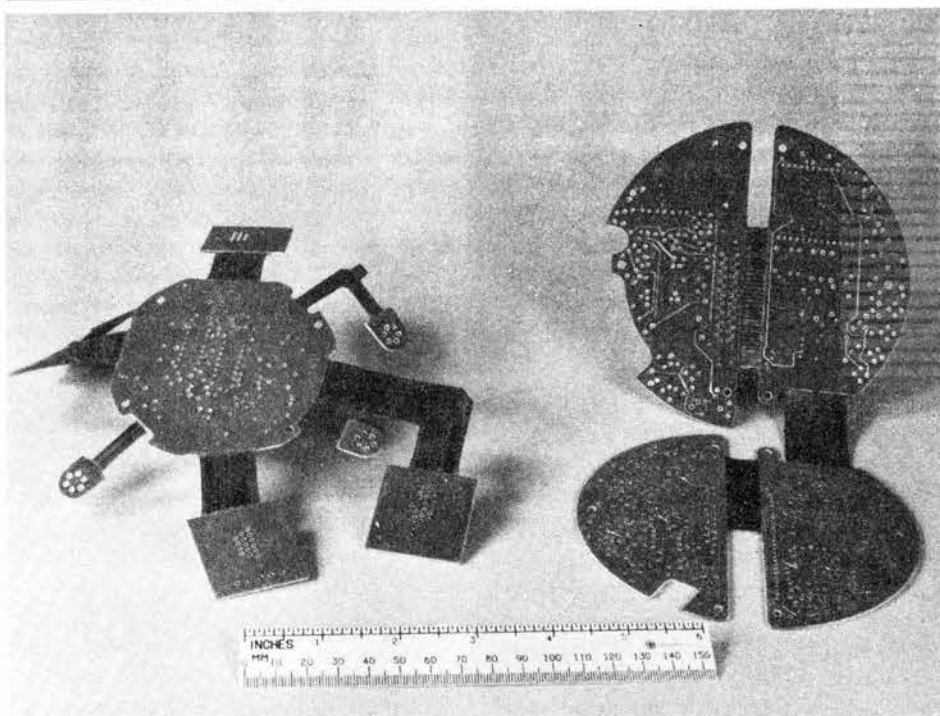
- Parachute-recovered, spinning artillery-fired projectiles should always impact the ground base first during testing. To assure this, we developed a six degree-of-freedom code to analytically describe the gyrodynamic response of a parachute-suspended, spinning shell. Analytical and experimental results showed conclusively that the Magnus moment vector is responsible for the unstable nutational motion of spinning artillery shells. By slightly ballasting the projectile, the direction of the Magnus moment vector can be controlled to assure stable dynamic equilibrium of the projectile. (8240)

- A robot was successfully introduced for spraying and inspecting light initiated high explosives (LIHE) applied to and detonated on weapon-related structures. This advance is significant for both test quality and faster response. We are now completing installation of a second robot to further increase testing capacity. Other recent advances include demonstration of a LIHE driven thin-foil flyer capable of generating substantially higher shock pressures in materials. LIHE testing is a unique Sandia capability. (7530)



THIS ROBOT sprays and inspects light initiated high explosives (LIHE) applied to and detonated on weapon-related structures.





RIGID/FLEX printing wiring boards eliminate discrete interconnecting and allow greater packaging density.

- Tonopah Test Range (TTR) successfully demonstrated the ability to relocate and operate major Range assets when resident capabilities at other test facilities are insufficient to support Sandia test operations. We also successfully demonstrated that major assets from other Ranges could be integrated into TTR's facilities to augment and enhance Range capabilities. The SWERVE III experiment required placing a precision tracking radar and a telemetry receiving station on Johnston Island. These systems were electrically interfaced with the Pacific Missile Range (PMR) trackers and the Kauai Test Facility (KTF) computers to provide downrange coverage of the event. An extensive Tomahawk cruise missile test at TTR required all of the normal Range assets, a number of

special measurements, and the use of equipment and personnel from White Sands Missile Range. (7170)

- The first flight configuration W88 Telemetry System was built and delivered on schedule; the unit is now in testing. This design marks a new generation of JTAs (Joint Test Assembly) because of the system's features: a remote data multiplexer is implemented in a single custom chip (designed and built at Sandia); each telemetry assembly contains five hybrid microcircuits and eleven Sandia-designed and built gate arrays; and system control comes from two microprocessors, each of which has essentially the computational capability of a single IBM personal computer. (5140)

## Components

- We demonstrated a new radar concept — the Directional Altimeter — for navigation based on terrain topography. This radar is intended for precise navigation at very high altitudes for maneuvering reentry vehicles like the Sandia SWERVE. Current topography-based systems, which use a radar altimeter to measure the terrain profile, are ineffective at high altitudes because the terrain measurement becomes smooth, and unique features are obscured. The Directional Altimeter measures range and two orthogonal angles to the closest point on the terrain; this measurement remains unique at high altitude. No other terrain-aided system has this capability. (1620/2340/5340)

- We developed a computer controlled ultrasonic scanning system to nondestructively evaluate welds. This enhanced ultrasonic capability displays lack of penetration defects, cracks in the heat affected zone, and profiles of the weld underbead. This technology was transferred to the Rocky Flats Plant for automated production inspections. (8440)

- Materials and processes have been characterized for developmental rigid/flex printed wiring boards. This is a unique electronic packaging concept that involves hybridizing a flex circuit with a multilayer rigid board

to form a single package. Higher density electronic circuits are now possible because of the elimination of hard wiring between wiring boards. Developmental boards have been successfully fabricated and delivered for such programs as the Trident II programmer and several programs for advanced development. (7470)

- We completed the design and fabrication of the first fully functional Arming, Fuzing, and Firing (AF&F) assembly for the W88/Mk5 Reentry Body (RB), which will be used in the new Navy Trident II Fleet Ballistic Missile Weapon System. The AF&F incorporates the latest advancements in fuzing technology, including a microprocessor based programmer, an all solid-state radar, a force-balance integrating accelerometer, a new integrated firing set, and an impact fuze. The fuze is designed to optimize target kill probability for given pre-reentry and reentry missile and RB error distributions. The fire set incorporates magnetically coupled strong-link nuclear safety devices and a new Plasmatron for delivering the firing signal through the fire set container. Test equipment to evaluate the performance of these complex subsystems during development experiments was also designed and the first units delivered. (2300/5150)

- A 16K fully static Complementary

tary Metal-Oxide-Semiconductor RAM (Random Access Memory) entered pilot production this year. Over 10,000 fully functional die were produced in support of Space Systems Department 5310 and several outside agencies. A complete characterization data base, including parameter distributions over environmental extremes, radiation characteristics in both total dose and transient environments, and single event upset response, has been compiled into a SAND report. (2140)

- We developed a radiation hardened complementary metal oxide silicon (CMOS) gate array for use in digital logic systems. The gate array is user configurable on the engineering workstations used by most of Sandia's subsystems groups. As a result, these organizations can do their own radiation hardened integrated circuit designs and have working prototypes in three months. The gate array approach has reduced both the time and cost of IC development by at least a factor of four. (2110)

- The first production application of a two-stage acceleration switch was started this year. A two-stage switch requires two or more consecutive stages of missile acceleration to actuate. The nuclear safety of systems incorporating this type of device is enhanced, since the switch is actuated only if proper staging of the missile occurs. The new production switch went into production this year. (2540)

- We developed a video monitoring system to observe Gas Tungsten Arc (GTA) welds being made on prototype parts and fixturing where visual access is limited by part geometry or because welding is being done in a glove box. Full color images produced by the system are sufficient in both size and detail to allow welding operators to monitor and control weld deposition. Video signals produced by the weld arc monitor may be recorded for later playback. Tapes thus produced are useful in operator training and quality control. We also developed special fixturing that allows the GTA weld to be viewed from an overhead position, as well as the usual view from the side seen by the unaided eye. (8180)

- We completed design of a miniaturized crystal clock to drive Sandia's new CMOS microprocessors. The clock, completely packaged in a single leadless chip carrier, required development of a number of new processes, a new integrated circuit, and a high temperature-compatible hybrid microcircuit. The 0.6 cm<sup>3</sup> clock features a 100 ppm accuracy over all environments. (2530)

- A new method of igniting explosive devices using very small semiconductor bridges (SCBs) was demonstrated. The SCB devices require less energy and function faster than conventional hot-wire devices, yet are as safe (or safer). Because of the low energies and voltages used, we were able to hybridize them with microelectronic technology and have created classes of "smart" explosive devices. Applications to nuclear weapons are being pursued and spin-off to the non-nuclear sector is expected. (2510)

- Hybrid microcircuit technology requires joining Au thick film coated components with solders such as Sn-In alloys. During processing and subsequent storage, the Au and Sn-In

react to form intermetallic compounds that can lead to component failures. This reaction has been characterized experimentally and the results used to evaluate (through mathematical modeling) the long term stability of such solder joints. Further, a thermodynamic and kinetic analysis of the Au/Sn-In reaction suggests the use of a new Au-Pd thick film ink that has better thermal stability. This application of the Au-Pd thick film ink is new technology not currently used in the private sector. (1830/2120)

- Sol-gel processing provides a convenient and versatile method of applying inorganic (normally oxide) coatings to glasses, ceramics, metals and plastics. Using metal alkoxide compounds of network forming elements as glass precursors, controlled hydrolysis and condensation in alcoholic solution cause the growth of inorganic macromolecules with tailored structures. We have prepared single and multilayer optical coatings (used to antireflect Si, glass, and lucite) with refractive indices ranging from 1.23 to 2.3 by controlling the composition and microstructure of the applied film. Dispersion of a second phase (glass frit, colloids, or fibers) in the coating solution prior to film deposition results in the formation of thick films useful for protective and dielectric applications. A patent was awarded the thick film process and a patent is pending on the processes involved in microstructure tailoring. (1840)

- Design was completed and construction started for the Radiation Hardened Integrated Circuit (RHIC) Laboratory. The facility's state-of-the-art vertical laminar flow clean room will provide the proper environment needed for the development of advanced radiation-hardened integrated circuit technologies. We collaborated with two commercial firms in developing and testing a unique floor system that enables us to achieve true vertical laminar flow and the required floor stiffness at considerable savings. An innovative ceiling system to insure clean room integrity was also developed. (7840)

- We participated in the qualification of a new component manufacturing facility at Rocky Flats Plant. The technical interaction was particularly extensive in weld process requalification for 17 components and in qualification of all-new acceptance testers for holographic interferometry, flow rate measurement, volume measurement, and proof/leak certification. (8440)

- In collaboration with Dept. 1840, we developed glasses that seal to titanium and Ti alloys. These glasses meet the special criteria for sealing to Ti: (1) thermal expansion coefficients that match Ti and Ti alloys; (2) thermodynamic stability with respect to reaction with Ti, and no gas phase reaction product formation at glass/metal interface (common in alkali silicate glass Ti systems); (3) sealing capability well below the allotropic phase transformation temperature of titanium, allowing retention of room temperature mechanical properties often lost during higher temperature heat treatment. These glasses now allow design engineers to consider the use of Ti in future components requiring glass to metal seals. (7470)

(Continued on Page Four)





PERCHED ON A PENNY is a semiconductor bridge (SCB). SCBs like this one have been hybridized with microelectronics technology to create classes of "smart" explosive devices.

- The need for welding current calibration prompted our design and construction of a power supply for installation at the National Bureau of Standards (NBS) in Gaithersburg, MD. The device will be used by the NBS to calibrate weld current sensors for use in high current (10,000-100,000 amps) resistance welders. The supply is a high output, pulsed, programmable current source capable of generating 60 Hz currents to 100 kA through a 10 microhm load in pulsed or continuous sinewave mode. The output waveforms simulate precisely those generated by resistance welders. This equipment increased the current generation capability at the NBS by an order of magnitude. (8180)

- A significant quantity of 15 different integrated circuits were delivered by the Center for Radiation Hardened Microelectronics to support the development of the Trident-II and Code Activated Processor (CAP) pro-

grams. These integrated circuits are now entering the production phase. Design definition for most of these devices was transferred to Bendix and initial WR wafer lots are being fabricated. (2120)

- We developed processes that were utilized in the successful fabrication of the first integrated circuit (IC) at Sandia with two levels of aluminum interconnection. These new processes included a plasma-assisted, chemical vapor deposited, interlevel dielectric; planarization techniques for the interlevel dielectric; plasma etching for intermetal contacts; and top layer aluminum interconnection. The first lot containing 16K random access memory (RAM) employing two-level aluminum interconnect yielded fully functional ICs that met the burn-in and radiation criterion of similar parts for Sandia's satellite programs. Processes for two-level aluminum interconnect will be implemented as part of CMOS IIIC technology development for many of Sandia's next generation ICs. (2140)

- We made a breakthrough in eliminating the initial voltage spike in thermal batteries designed and developed by the Power Sources Department. Earlier attempts to control the spike by using an additive in the cathode, though workable, have proven difficult to control. The new method, under patent disclosure protection, introduces no new materials into the cathode. Instead, the approach recognizes the thermodynamic prediction of the voltage spike as given by the Nernst equation, and incorporates the principle of "lithiating" the cathode so that the battery reaction, in effect, begins partway into the discharge. Not only has the voltage spike been totally eliminated, but the use of the new cathode material in long-life batteries provides substantially improved performance in activated lifetime. (2520)

## Energy

- In the magnetic fusion program, the Plasma Materials Test Facility was brought into operation in Area III during the year. A 40 keV, 20A ion source was delivered and operated. An electron beam test system was used for extensive thermal response tests on materials used in vessel components. These included simulation of disruptions and heat removal studies for actively cooled diverter targets. A comprehensive study of thermal fatigue of beryllium led to the decision to continue development of beryllium limiters at the JET tokamak, which is the flagship of the European fusion effort. (6240)

- We initiated an unprecedented set of long-term tests in the underground salt formation of the Waste Isolation Pilot Plant (WIPP) near Carlsbad. The tests address the effects of salt creep (including the effects of waste heat) on underground openings as well as the performance of a variety of defense waste packages. These large scale tests will provide information that is to be used to validate predictive performance models, and involve more than 4000 channels of data that will be accumulated for at least three years, in most cases considerably longer. The tests will provide an important technology

base for future repository design and for evaluation of waste isolation performance for WIPP. (6330)

- High Energy Gas Fracturing (HEGF) experiments, utilizing tailored propellant charges, established the phenomenology for dynamic fracturing in cased and perforated wellbores. Fracturing through cased and perforated wellbores was successfully achieved with no attendant casing damage. This establishes HEGF as a viable wellbore stimulation technique for a significant fraction of the 95 percent of oil and gas wells that are cased and perforated. Our work has catalyzed industry's development and application of this fracturing technology. (6250)

- Major steps in final hydrologic and structural site characterization of the Waste Isolation Pilot Plant (WIPP) site were accomplished this past year. Hole DOE-2 was sited near the center of a structural depression near the site, drilled to a depth of greater than 4000 feet, cored, and hydrologically tested. Core analysis indicates the structure was not due to dissolution of salt by groundwaters. A regional-scale pumping test was conducted over several square miles to investigate the hydraulic properties of the main "aquifer" at WIPP. This

is the first such test conducted as part of U.S. programs in nuclear waste disposal. Major progress was also made in updating our ability to interpret the results of hydraulic well tests and it is now evident that fracture systems play a significant role in WIPP hydrology. (6330)

- Under our technical direction, the first year of power production was successfully completed at the 10 MW<sub>e</sub> Solar Central Receiver Pilot Plant near Barstow, California. More than 7,000,000 kilowatt hours of electricity were delivered for use by customers of the Southern California Edison Company. We incorporated several changes to the solar equipment and operating methods to improve energy production from the plant. We completed a comprehensive evaluation of the performance of the plant using data obtained during an earlier Test and Evaluation Phase and published a final report documenting the results. (8470)

- Using a high-sensitivity laser-initiation/laser-probe technique, we measured absolute rate coefficients as a function of temperature for the hydrogen-atom transfer reactions  $\text{OH} + \text{C}_n\text{H}_{2n+2} \rightarrow \text{H}_2\text{O} + \text{C}_n\text{H}_{2n+1}$ . Selective deuteration of the alkane enabled us to quantify for the first time the reactivity at individual C-H bond sites in molecules such as ethane, propane, and isobutane. These reactions represent the principal mechanism of fuel consumption in lean and stoichiometric alkane/air flames, and their characterization is of crucial importance to models of combustion processes. (8350)

- Transportation of spent nuclear fuel and high-level wastes to the first repository is a key element in the commercial waste management program. Public concern has centered on the costs and risks that could result from shipments from reactors and high-level waste generating sites to the candidate repository sites by truck or rail. To assist the efforts of the DOE Office of Civilian Radioactive Waste Management, we analyzed these impacts and published "A Preliminary Cost and Risk Analysis for Transporting Spent Fuel and

High-Level Wastes to Candidate Repository Sites." This analysis was a key input to the OCRWM Draft First Repository Environmental Assessment. These data were further used as a justification for the OCRWM sponsorship for the cooperative development of higher-capacity future generation casks for transportation of spent fuel and high-level wastes. (6320)

- The Multiwell Experiment, a field laboratory in western Colorado, reached its halfway point. Its objective is the tens of years supply of natural gas in the lenticular, low-permeability gas sands of the western U.S. We developed new technology to help an operator interested in exploiting this resource: improved core and log analyses, methods to define the shape of individual sands, the importance of natural fractures on production, in situ stress methods for hydraulic fracture azimuth and height predictions, new operational procedures, and new analytical modeling techniques. (6250)

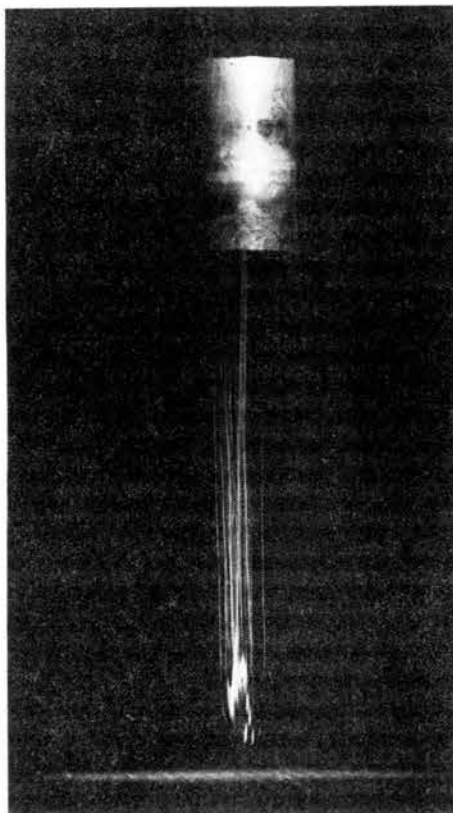
- Partially combusted char samples are being analyzed by electron microscopy techniques to obtain time-resolved information on the production of mineral ash during coal combustion. Unlike traditional mineral/ash analyses, these electron microscopy techniques can be used directly on raw coal and char samples, can monitor specific chemical elements, and can quantitatively determine ash particle size distributions. To obtain the specimens for this work, we developed an isokinetic quench probe for use in a laminar flow reactor that enables us to sample the coal char being produced in the reactor after various stages of combustion. This type of detailed analysis has not been attempted previously, but is necessary to provide a fundamental understanding of the behavior of coal mineral matter during combustion and the deleterious role this mineral matter plays in commercial utility boiler operation. (8360)

- Geothermal, fossil fuel, or magma energy development requires detailed knowledge of underground resources. Seismic imaging tech-



THIS TEST ROOM AT WIPP simulates an upper heat limit for the disposal of Defense High Level Waste (DHLW).





IN COAL COMBUSTION studies, a rapid-quenching sampling probe (top) is used to extract partially reacted material from reactors. Each sample is analyzed off-line for its organic and mineral content.

niques can be used to map bodies of oil, gas, or magma that appear as structural irregularities with lowered seismic velocities. We utilized seismic tomography to search for shallow magma bodies in the Coso region of California. Inversion of more than 4000 local earthquake travel times for 3-D structure reveals a shallow (3km) anomaly beneath Indian Wells Valley, making it an exciting site for future magma energy exploration. (1540)

- In support of the DOE effort to nominate a site for the nation's first high-level radioactive waste repository, we played a major role in the preparation of a final environmental assessment to provide the technical evidence for nominating the Yucca Mountain site in Nevada. The revised assessment, to be issued in final form in 1986, provides responses to public and other government agency comments and contains revised analyses evaluating a repository system at the site and predicting its long-term performance. A major study among these new analyses is a stochastic calculation of the time required for ground water to travel from the repository to the aquifer beneath the site. The calculation takes into account the natural variations in hydrologic properties of the rock at the site; it predicts a distribution of travel times that can be compared with the regulatory standards governing those times. In addition, more recent repository design configurations and associated impacts were developed and described in the document. (6310)

- We accomplished a major technical breakthrough in our support of the performance assessments required for the Yucca Mountain repository site evaluation. We completed physical visualization and developed a mathematical model to predict fluid flow in an unsaturated, highly fractured rock mass. Studies performed to characterize this site and to evaluate potential transport of radionuclides require a model that can calculate water movement in both rock matrix and fractures in an unsaturated medium. We developed a con-

tinuum model because it is calculationally and economically impractical to discretely model the large number of fractures contained in a site-scale problem. This model is currently used in the computer code TOSPAC developed at Sandia to support performance-assessment studies. (6310)

- We are responsible for directing advanced high efficiency concentrator photovoltaic (PV) cell research for DOE's Solar-Electric Program. In the past year two major accomplishments resulted from this research. First, a new PV record efficiency was established with the demonstration of a 26 percent efficient concentrator GaAs solar cell by Varian Associates. This cell, evaluated at Sandia, has high efficiency at 200 to 800 suns (1 sun = 1 kW/sq.m) concentration. Second, a 25 percent mechanically stacked multiple junction device (evaluated at 70 suns) was developed by Hughes Research Labs, Applied Solar Energy Corp., and Sandia. This also represents a new high efficiency for this type of technology that ultimately has potential for greater than 40 percent solar-to-electric conversion efficiency. High efficiency PV devices are a key element in developing a cost-effective PV technology that competes with fossil fuels for the bulk electrical power market in the U.S. (6220)

- To prove the feasibility of a molten salt solar central receiver system, the Molten Salt Electric Experiment (MSEE) was built and tested at the Central Receiver Test

- To determine the scientific and engineering feasibility of optical lasers excited directly by a nuclear reactor, recent experiments on SPR III (Sandia's Pulsed Reactor facility) demonstrated optical gain. The magnitude and temporal behavior of the gain indicate that population inversions are efficiently produced by reactor pumping and that late-time kinetic processes will not limit system performance. (1120/6420)

- Research on compound semiconductor strained-layer superlattices (SLSs) led to three technologically important results: (1) These SLS structures were shown to be significantly more radiation-hard to both gamma and neutron irradiations than bulk alloys of similar compositions; (2) It was demonstrated that SLSs can be used to completely eliminate threading and misfit dislocations in semiconductor heterostructures. This result makes it possible to grow dislocation-free material on poor quality substrates and affords heretofore unattainable flexibility in the choice of substrate materials for semiconductor devices; and (3) A Strained Quantum Well transistor has been fabricated. This device has tied the world's record for room temperature gain in other materials and offers several operational advantages over previous devices. (1130/1140)

- We developed a computer code to perform fully coupled two-dimensional calculations of the electromechanical response of dielectric materials such as piezoelectric crystals and ferroelectric ceramics. Calculations with this code revealed regions, not previously known to ex-

ist, where high electric fields develop during operation of an explosively driven ferroelectric power supply. Such regions of field concentration can lead to breakdown and degraded component performance, so the ability to identify and eliminate such regions is important for improving our device designs. (1530)

Facility (CRTF) in Albuquerque. The objective of this full-system experiment was to evaluate molten salt components and the operation and performance of the overall design. The experiment was completed successfully last year. It employed a 5MW<sub>t</sub> receiver and a two-tank thermal storage unit integrated with a salt-to-steam heat exchanger and a 750 kW turbine generator. Six teams of operators from participating utilities and industry completed hands-on training courses using this equipment. Our goal was to convey information and experience relating to the operation of a molten salt central receiver. In return, we obtained feedback from the operators on the system design, operation, and digital control network. The full system was operated as a utility during April and May, and detailed receiver performance experiments were completed during June and July. (8470)

- A U.S. patent was awarded for the development of a novel class of hydrous metal oxide ion exchange catalysts. These materials have extremely high activities for catalytic hydrogenation and can be utilized at mild operating conditions (e.g., 100°C) where commercially available catalysts are virtually inactive. Hydrous metal oxides show promise for a wide range of chemical processes including coal liquefaction, hydrocracking, reforming, and methanol synthesis. (6250)

- We developed an expert system development language that allows easy construction of prototype expert

## Research Sciences

face. (8340)

- A mathematical model and computer code were developed for calculating the flow field and drag of high speed underwater vehicles. This is the first successful method for predicting the cavitating flow field and all of the drag components: skin friction, pressure, and base drag. We used the code for high speed water entry and underwater trajectory calculations of Sea Lance, Anti-Submarine Penetrator, and Nuclear Depth/Strike Bomb. (1630)

- Kinetic and microstructural studies of rapid solidification are providing new insights in both semiconductors and metals. In ion implanted silicon irradiated with a pulsed laser, simultaneous measurements of melt-depth and time using transient conductance, and the melt duration at the surface using time-dependent reflectance, revealed unexpectedly that for a variety of conditions, melt initiates inside the sample to produce buried molten layers. This behavior is in contrast to that for pure silicon, in which melt initiates at the surface and propagates into some depth. Our discovery of internal melting with buried molten layers explains many of the unusual microstructures, including buried metallic films, observed after pulsed laser melting.

- In metals, ordered icosahedral phases of solids, exhibiting sharp diffraction spots with five-fold symmetry, were developed by rapid quenching from the melt. Because this symmetry is not allowed in normal crystals, which have translational invariance, this new form of order was termed "quasicrystalline."

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Quasicrystals have been produced at Sandia in aluminum-manganese alloys by a variety of techniques for the first time, including pulsed surface melting using laser and electron beams, ion beam mixing, and solid state diffusion. Our studies provided the first estimates of the melting point and show that the quasicrystalline material forms very rapidly from the melt. Based on theoretical suggestions, we plan to examine the mechanical properties of this unique phase of matter for potential friction and wear applications. (1110)

• Unique surface chemical behavior can be obtained by combining elements on a solid surface. For example, submonolayer amounts of Cu on the Ru (0001) surface yield catalytic properties that are not like those of either Cu or Ru but which exhibit greatly improved behavior for certain reactions. It has recently been shown that Cu is adsorbed on the Ru surface under a 5 percent tensile strain with respect to bulk Cu and that the electronic properties of this strained metal overlayer are specific to the strained interface. (1130)

• Stress corrosion cracking degrades strength and can cause catastrophic failure in load-bearing ceramics. We found that the molecular size of active chemical species can control their ability to promote crack extension. Reactive molecules do not promote slow crack growth if they have a dimension that is larger than the dimension of an atomically sharp crack. Furthermore, steric effects also influence crack tip reaction rates for small molecules, e.g. methanol (0.25 nm) is 10,000 times less effective in promoting crack extension in silica than is water (0.15 nm). These results suggest that adsorption of bulky chemicals on crack walls may

drastically reduce stress corrosion crack growth effects. (1840)

• A new class of self-developing positive-working polysilane photoresists was discovered. Exposure of these new resists, a class of novel silicon-backbone polysilane copolymers, to deep UV light results in decomposition of the polysilane to volatile, chemically inert cyclic siloxanes, leaving an image. A resolution capability of at least 0.8 micron has been demonstrated for these materials. Moreover, the self-developing polysilanes have exceptionally high resistance to oxygen-reactive ion etchants. This quality makes them the only self-developing imageable etch barriers available for use in bilayer lithography processes. These materials have shown great promise for photolithographic applications ranging from VLSI circuit fabrication to printed circuit board manufacture. Composition of matter and process patents covering the polysilane resists have now been allowed and several license applications have been filed with DOE by companies desiring to manufacture and distribute the materials to the microlithographic industry. (1810)

• Building upon our recent successes in producing low density, microcellular foams from polymer solutions, we extended this understanding to allow the precise manipulation of the resulting microstructures. With the proper selection of processing variables, the morphology of the foam may be varied continuously between physical extremes. For instance, as overall density is changed, the average tortuosity of the foam may be varied from that of an open net-like structure to that reminiscent of a closed-cell gas blown foam. (8310)

## Safeguards

• A new Test/Operations facility was designed and built at the Tonopah Test Range. The facility provides appropriate safeguards during and after weapons system gun and air drop tests that are performed at the range. A team of technical staff from Departments 5210, 5240 and 5260 assisted TTR (Department 7170) in defining the new facility and in field implementation of the integrated security system. (5260/7170).

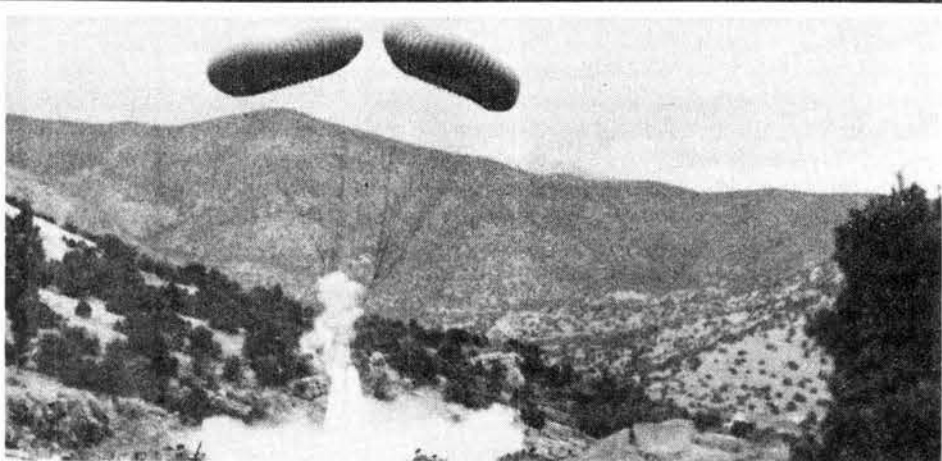
• A broadband data bus was developed as part of the Modular Building Block approach to designing and building Command, Control, and Communications systems. The concept is to configure equipment into Modular Building Blocks (MBB), to interconnect them with an RF broadband data bus, and to control the network topology with an automated tech control processor. The broadband bus provides a versatile capability that can accommodate a large number of users, communications protocols, and physical topologies. The data bus provides connectivity for a variety of different types of circuits including digital, audio, and video. (5250)

• An interactive computer program for perimeter lighting simulations and design was developed as a tool to aid in the design of exterior lighting systems. Although it is used primarily for perimeter security-lighting design, it has potential for any application where the light can be

approximated by a point source. A data base of luminaire photometric information is maintained for use with the program. (5240)

• As part of the barrier evaluation program, barriers that prevent ground vehicles from successfully penetrating perimeters of facilities are being tested. Thirteen barriers were analyzed and tested to determine their stopping effectiveness and to understand parameters affecting the outcome of a penetration attempt. This project culminated with a conference held at Sandia in which attendees from numerous U.S. Government facilities discussed problems and solutions. (5250)

• A low cost Alarm Multiplexer Communication System (AMCS) was developed to perform the security sensor monitoring and control function and to provide remote relay control capability for integrated security systems. AMCS has a distributed multiplexer/repeater architecture with up to four dual communication loops. We designed a configuration that employs dual control computers that guarantee total system operation under any single point failure condition. All AMCS hardware is commercially available and controlled by Sandia-designed software. Each AMCS can control up to 4096 sensors and 2048 remote relays, with a fairly constant cost per channel independent of the system size. AMCS is being



A SYSTEM THAT can airdrop resupply materials from low altitudes was successfully tested at the Cable Test Facility last year.

## Reimbursables

• Transport of electron beams using preionized channels in low pressure gases is an attractive alternative to the use of strong magnetic fields to provide the focusing and guiding forces. In the past, application of this technique relied on photoionization of high molecular weight organic gases (e.g., benzene or diethylaniline) with ultraviolet laser light. We developed a technique for creating the plasma channels using impact ionization by low-energy electrons emitted from a heated filament cathode immersed in a weak confining magnetic field. With this technique we can ionize transport channels in any gas and easily diagnose the channels using simple Langmuir probes. Furthermore, because these channels can be confined in curved sectors of the transport tube, we can use them to guide high-energy beams through circular or recirculating accelerators. During the past year, we used this channel production method to demonstrate high-energy beam guiding around a 90 degree curved section preparatory to application in a recirculating accelerator. We also used the technique to guide a beam through an auto-accelerator, and to transport the RADLAC II beam from the accelerator to the launch point for the open-air propagation tests. This was the first time that a rotating (spinning) beam has ever been transported using an ionized channel. (1270)

• The development of a terrain-

aided land navigation system with a color map display output was completed. The system provides real-time indication of vehicle position. Range and bearing to a selected location are presented and updated in real time. Also calculated is visibility from any observation point. The system was tested at Edgewood, N.M., and results indicate that accuracies on the order of 100m can be attained using data from widely available maps. The system was demonstrated to Army civilian personnel, and a videotape was produced for dissemination within the military community. (5340)

• The Tactical Remote Sensor System (TRSS) is a set of unattended ground sensors and monitor equipment to be used by the U.S. Marine Corps for battlefield surveillance and intelligence collection. We completed the system definition phase of the program and successfully tested prototype sensors in preparation for operational test and evaluation by the Marines. At their request, we also developed a sensor for use with the monitor equipment from the Marines' existing battlefield sensor system. Testing of this sensor was completed and the design was transferred to the DoD for immediate production. This will enable the Marines to maintain their current battlefield sensor capability until the TRSS becomes available. (340)

• Research focused last year on developing the technology base re-

(Continued on Page Seven)

used by and considered for several DOE and DoD facilities. (5240)

• The Sixth International Training Course on the Physical Protection of Nuclear Facilities was held last fall in Albuquerque. The intent of this course, which is sponsored by the Department of Energy (DOE) and the International Atomic Energy Agency (IAEA), is to transfer physical protection technology to developing and developed countries, as required by the Nuclear Non-Proliferation Act. Twenty-five students representing eighteen countries participated in this course. In addition to Sandia lecturers, eight countries sent guest lecturers, as did the DOE, the IAEA, NRC, and Los Alamos National Laboratory. (5210)

• We developed a sensor that can detect helicopters. The device, which is entirely passive, does not require line-of-sight to the helicopter and relies on the long-term correlation of acoustic and seismic signals from the helicopter. Other noise sources (e.g., vehicles, motor-generators) typically

do not produce long term correlated acoustic and seismic signals, and do not cause alarms. The system has been implemented in a portable microprocessor-based prototype and has been widely tested. (5230)

• We developed prototypes of a new Tactical Engagement Simulation System (TESS) to be used for guard training. The guards' weapons, which fire blank ammunition, also shoot a laser beam at the target. Each laser beam includes a message that identifies the guard who fired the weapon. Near-miss and hit data are stored in the receiver systems of the participants to provide an accurate account of the results of the engagement. A weapon disable signal is included to turn off the laser weapon of a participant who has been hit. An optional data link radio can be added to provide real-time data collection. The TESS equipment will significantly improve the training of security personnel and the evaluation of the performance of personnel and tactics. (5210)



quired to quantify radionuclide release in the event of severe nuclear power plant accidents. Two major phenomenological release models were developed and provided to the Nuclear Regulatory Commission for use in its evaluation of public risk from such accidents. The models, describing radionuclide release from degrading fuel rods and from ex-vessel core-melt concrete interactions, compute the thermodynamic disequilibrium that acts as the driving force for release as well as the mass transport kinetics limitations to release. Experiments in the Annular Core Research Reactor involving fuel rod meltdown, as well as large-scale tests with molten fuel and concrete structural materials, are being conducted to identify the dominant physics and chemistry controlling release and to provide data for model validation. (6420)

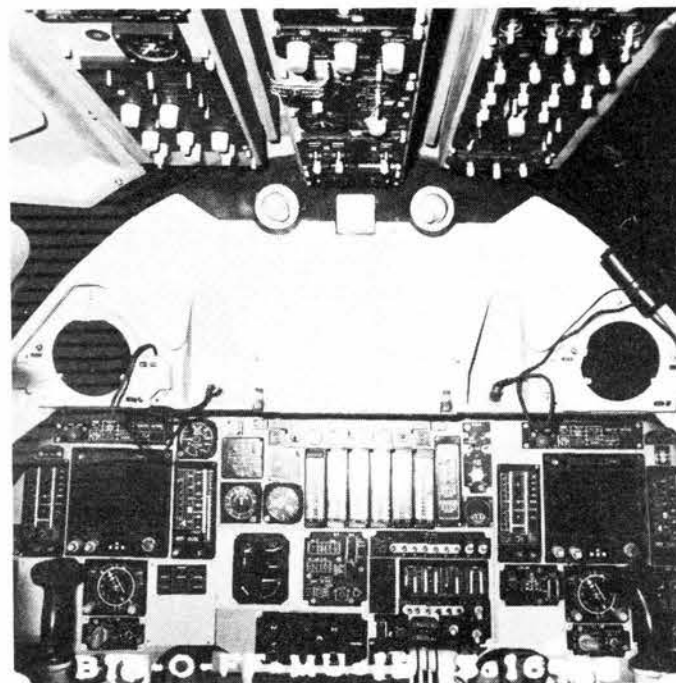
- Since the "Rasmussen Report" on nuclear reactor risks was published 10 years ago, the Nuclear Regulatory Commission (NRC) has sponsored research and analyses to increase our understanding of nuclear reactor accidents. To support NRC's decision making next year on severe accidents, we have led the effort to reevaluate the risks from nuclear power plant operation incorporating the full body of information now available. A key accomplishment was the development of methods to evaluate the various pathways reactor accidents could take from the time of assumed core melting to the time of containment failure. This so-called "containment event tree" methodology is being transferred to other national laboratories and to the nuclear reactor industry. (6410)

- As part of the Strategic Defense Initiative (SDI) Space Power Program, we developed a procedure using parametric calculations to estimate the power required for free-electron laser, neutral particle beam, and electro-magnetic launcher weapons. The calculations, based on current estimates of the lethal energy required on targets, will be updated as technologies evolve. Also,

reference system models are being developed for power systems, power conditioning systems, and pulse forming networks. These models, along with basic materials studies and overall systems engineering analyses, are enabling evaluation of candidate concepts and technologies. Thus, SNL is playing a vital role in evaluations and analyses whose results are used extensively in helping direct the Multimegawatt Space Power Program. Preliminary recommendations have identified attractive concepts and necessary technologies that need further development for the Multimegawatt Space Power Program. Sandia will also play a major role in the Multimegawatt Technology Program. (6430)

- A ground antenna system capable of simultaneously tracking and acquiring data from six Global Positioning System/NUDET Detection System (GPS/NDS) Block II satellites was developed. The antenna consists of an electronically steerable array of 46 elements mounted on a 29-inch diameter hemispherical dome. Signals from these elements are combined to form six independent antenna beams that can be aimed at the GPS/NDS satellites. As the in-view satellites move, elements are switched on and off to steer the beams, thereby maintaining tracking for continuous data acquisition and real-time reporting to DoD users. (5320)

- Our research supports the Nuclear Regulatory Commission's evaluation of the vulnerability of safety equipment to nuclear power plant accident environments. Numerous tests on organic materials, electrical cables, electrical penetration assemblies, and large battery cells were conducted under various seismic, radiation, and steam-pressure stresses. Tests were conducted using facilities developed by Sandia and under joint programs with Canadian and French organizations. Most equipment performed as designed and even beyond design requirements, but some unique failure modes were observed. The informa-



PILOT AND CO-PILOT view of B-1B instrumentation panel, showing two of the cockpit's six triangular-shaped PLZT protective window systems developed at Sandia.

tion is directly used in NRC regulations and utility licensing activities. (6440)

- A Performance Assessment Methodology (PAM) was developed for the Nuclear Regulatory Commission (NRC) for use in assessing the risk from disposal of radioactive wastes in deep geologic formations. The PAM consists of (1) methods for selecting and screening potentially disruptive events and processes (scenarios), (2) mathematical models for estimating consequences from scenarios, and (3) probabilistic and statistical techniques for use in sensitivity and uncertainty analyses. The PAM can be applied to repositories located in saturated formations that are considered to be either porous media or fractured-porous media. The PAM is being used by several federal government agencies, universities, and industrial subcontractors to the NRC. Several computer codes, designed to describe radionuclide/fluid/rock interactions and to calculate radionuclide releases, were assembled on the Sandia computer system. These are the MINEQL code, used to model radionuclide sorption, the PHREEQE code, used to examine possible ground-water evolution paths at potential repository sites; and the TRANQL code, used to model coupled speciation-transport. Methods for determining probabilities of occurrence of geologic events and processes of interest to geologic disposal of radioactive wastes are being developed. The use of probabilities is required by the Environmental Protection Agency Standard for geologic disposal of high-level wastes. State-of-the-art techniques for predicting geologic events and processes were identified. (6430)

- Significant progress was made in providing the Nuclear Regulatory Commission with a capability to evaluate and improve reactor containment building integrity if threatened by detonations occurring in mixtures of hydrogen, air, and other gases. Detonations were shown to be more likely with increasing ambient pressure or temperature (at constant volume) and with decreasing dilution by steam or carbon dioxide. A large-scale channel, 6' by 8' by 100' long, was used to study spontaneous deflagration to detonation transition (DDT) under various conditions. DDT was observed in a test with about 15 percent hydrogen, the leanest concentration ever shown to result in DDT. Tests also showed that

obstacles tend to enhance the possibility of DDT, and that, in some cases, vents acted as obstacles to increase, rather than decrease, the possibility of DDT. (6420)

- The Retrorocket Assisted Parachute Delivery (RAPID) System is being developed to provide the DoD an ability to airdrop resupply materials from low altitudes. A prototype system consisting of parachutes, rocket module, radar altimeter, command logic computer, firing set, and safety components was successfully tested at SNL's Sol Se Mete Canyon Cable Test Facility. Touchdown velocities less than 10 feet per second were achieved. (1620/ 1630/ 1650/ 2330/ 2510/ 7130/ 7530)

- We completed the structural analysis of several new armor piercing projectiles for the U.S. Army's Armor Enhancement Initiative. We also developed analytical and new material models and experimental techniques to predict and measure the engagement interactions of obturator banded projectiles in smooth bore gun tubes used to launch armor piercing projectiles. (8240)

- Development was completed of a real-time ground data processing system that provides the DoD with a nuclear burst reporting capability for the Global Positioning System/NUDET Detection System (GPS/NDS) Block I satellites. The system processes and displays data that are forwarded from three remotely located receiving stations. The completed system contains approximately 300,000 lines of computer code. (5320)

- In cooperation with MIT/Lincoln Laboratories, we launched several sounding rockets from the Kauai Test Facility to measure laser beam propagation through the atmosphere. A Sandia-developed Attitude Control System continuously pointed a detector array in the payloads toward the ground based laser throughout the 12 minute flights. Telemetered detector signals provided a gauge of the effectiveness of experimental techniques for maintaining beam collimation through a turbulent atmosphere. (7520)

- We participated in a multi-laboratory, nine-month effort to evaluate candidate technologies for both near and far term architectures for strategic defense, to identify key issues associated with various system configurations, and to provide an assessment of options independent of several contractor teams tasked with

## Treaty Verification Technologies

- The last of the developmental series of Global Positioning System (GPS) satellites, with Sandia instrumentation aboard, was launched in October. It is the fourth GPS satellite capable of detecting nuclear detonations (to verify compliance with the Limited Test Ban Treaty). The detection systems include a Sandia-designed optical fireball sensor and a microcomputer-based logic system that collects and processes the data for relay to user receiving stations. All four satellites are in circular orbits 10,900 nautical miles above the earth's surface in an environment that requires radiation-hardened electronic parts. Some of these parts were supplied by Sandia's Center for Radiation-hardened Microelectronics. Delivery of updated Sandia instrumentation for a new constellation of 21 GPS satellites has begun. These spacecraft will be launched from the space shuttle beginning in 1987. When these satellites are operational, they will provide full-time capability to detect and locate nuclear detonations anywhere in the

earth's atmosphere. (5310)

- Working jointly with Los Alamos National Laboratory, we completed development of advanced radiation monitoring instrumentation systems for use on Air Force Defense Support Program satellites and Global Positioning Systems satellites. The systems consist of sensors designed and provided by Los Alamos and data processing logic designed and provided by Sandia. Data from instrumentation of this type flown on earlier satellites have already contributed substantially to an emerging understanding of natural background radiation in space, and to surface charging and other radiation-induced effects on spacecraft. These effects are suspected of having caused component failures in a number of U.S. satellite programs over the years. By studying the environment prevailing at the time spacecraft problems occur, correlations are being developed between the environment and component failures. This information is used to implement corrective designs for future satellite systems. (5310)

(Continued on Page Eight)



a similar assignment. Key contributions by Sandia participants included definition of the projected threat and countermeasures, analysis of the survivability of defensive system components, and development of an architecture for boost/post boost intercept of Soviet ICBMs and SLBMs. (8470/330)

- The preliminary design of a conventional (non-nuclear) weapon system fuze has been completed. The basic design is an extension of DOE nuclear weapon design technologies, and utilizes Sandia's background in earth penetrator design to provide an adaptive fuze that makes fuzing decisions based on warhead/target interaction dynamics. Additionally, the use of DOE high energy detonation technology will allow removal of costly, interrupted, explosive firing-train components and provide the DoD with

significantly increased fuze testing capability. (5340)

- We upgraded our thermal/flash protection shutters by improving switching speed via redesigned discharge circuitry, eliminating high temperature/high humidity susceptibility with new glass-to-metal sealing techniques, achieving a continuous 12-hour minimum operation capability, and improving transmission with new polarizer developments. As a result of the upgrade to acceptance specifications, the USAF has released a \$12 million request for procurement to provide Sandia-designed protective windows on 97 B-1B aircraft. Production windows and electronics for the first B-1B aircraft were delivered in early September and have been successfully test flown in the aircraft. (2530)

## Pulsed Power Development

- The Particle Beam Fusion Accelerator II (PBFA-II) was completed within budget in late 1985, more than a month ahead of schedule. The accelerator, designed to produce 100 trillion watts of power and 3.5 megajoules of energy in a pulse lasting 50 billionths of a second, was tested for the first time on Dec. 11; preliminary results look good. (1250)

- We completed experiments on a four stage accelerator to demonstrate the High Energy Linear Accelerator (HELIA) concept. HELIA uses modular, water-dielectric pulse forming lines to drive inductively isolated cavities. The voltage outputs from these cavities are added along a magnetically insulated transmission line (MITL), and the power is delivered to a high-voltage diode at the end of the MITL. The concept of using a MITL to sum the voltages from induction cavities is new and promising for many applications. The most immediate application of

HELIA technology is Hermes III, which will produce a radiation pulse for nuclear weapon effects simulation. This accelerator is being developed to meet DOE gamma-ray simulation needs in the 1990s. (1240)

- The final year of operation of the Particle Beam Fusion Accelerator I (PBFA-I) culminated in a focused proton beam at 1.5 TW/cm<sup>2</sup>. This achievement resulted from improvements in our understanding of acceleration gap physics, particularly in establishing a prompt, properly aiming virtual cathode. Beam neutralization in the transport to target was also essential. Both of these advances were made by novel designs, utilizing plastic meshes in the diode itself. Further improvements to the timing synchrony of the 36-module accelerator symmetrized the power flow to the diode where XUV preionization achieved faster, more uniform particle extraction. (1260)

## Computing

- In the role of lead laboratory for integration of Computer Aided Design (CAD) and Computer Aided Manufacturing (CAM) for the Nuclear Weapons Complex (NWC), we developed a means for translation of design definition graphics data among the five diverse CAD systems in use across the NWC. A set of computer codes, which augment the Initial Graphics Exchange Standard (IGES) software supplied by all major vendors, provides complete, accurate translation of CAD drawings. This system is being implemented across the NWC. (2810)

- We continued to increase our computations capabilities at SNLL to keep pace with the demanding needs of weapon design. Our new Technical Control Center (TCC) came on-line in mid 1985. It controls data communications from both terminals and computers at speeds up to 56 kilobaud and occupies approximately 1200 square feet of the Central Computing Facility. As part of the TCC, a new port contender allows 1024 terminals to access 512 ports. Other recent changes include the addition of a QCR matrix camera for 8x10 glossy photos or viewgraphs, a second QMS laser-graphics printer, the removal of the last CDC 6600, and upgraded operating system and utility software on all major CCF hardware. (8230)

- To provide for graceful system

augmentation and to avoid difficult resource reconfigurations, we created a Local Area Network (LAN) using Ethernet and optical fiber technologies for the Div. 2813 CAD/CAM system. We also provided the expertise to double the range of commercially available optical Ethernet repeaters to meet difficult link requirements. (2630)

- The Central Computing Facility's capability was greatly increased by the installation of a Cray X-MP/24 computer. In addition to providing increased computing throughput, the new machine runs the Cray Time Sharing System (CTSS) and provides the new capability of running jobs interactively as well as in the batch mode. A major upgrade in the Central Computing Network was accomplished through the addition of nodes to permit interactive computing, access "security" verification, an Automated Tape Library, and an "Output Node" to permit users working at their local machines to obtain graphic and microfilm output. (2640)

- We developed an approach to Software Quality Assurance (SQA) that is tailored to the traditionally parallel and iterative development and production-related activities and to the complex test equipment typically found within the DOE complex. This approach to SQA permits

## Miscellaneous

- We carried out experiments in the Tritium Research Laboratory to establish that proposed weld repair procedures for a nuclear reactor would not significantly degrade the ductility and fracture toughness of the irradiated reactor vessel wall. The key information necessary for demonstrating the safety of the repaired reactor was obtained by charging the reactor vessel stainless steel with tritium, allowing a portion of the tritium to decay to helium, and then measuring the low temperature mechanical properties of the helium-bearing metal after subjecting it to transient high-temperature annealing cycles. In the walls of the actual reactor vessel the helium is generated by transmutation of boron and nickel due to thermal neutron bombardment. These studies dispelled concerns about the potential for helium embrittlement in the context of the repair of this reactor and enabled repair plans and safety evaluations to proceed in a timely fashion. (8310)

- The Uniformly Redundant Array experiment (URA), a cooperative effort among Sandia, Los Alamos National Labs, and Columbia University, was delivered to Lockheed in Sunnyvale, California, for integration into its space shuttle pallet. The URA experiment, which is an X-ray telescope, is designed to provide high-resolution images of cosmic X-ray sources such as the Crab Nebula and the galactic center. It will be part of the first space shuttle mission to be launched from Vandenberg AFB in California this summer. Department 320 designed, built, and tested the control and processing electronics, and also designed and tested the software for the on-board multiprocessor computer system. Department 5310 designed and built the mechanical structure supporting the electronics. Department 1510 designed, developed, and tested the thermal control system, which maintains temperature-sensitive detectors to within  $\pm 1$  degree C while operating in the temperature extremes of space. (320/1510/5310)

- We developed techniques and facilities to measure the flow rates of standard gas leaks. This calibration capability has given us the special national position of being the preferred center to provide this service. In recent years, the need for leak calibra-

tions has grown, a prominent stimulus being the development of transportation technology for nuclear waste. As a result, the National Bureau of Standards (NBS) began to develop its own leak calibration facilities. (7240)

- Microwave standards are now calibrated on three new systems. The Dual 6-Port Network Analyzer characterizes components to fractions of a percent accuracy. The Weinschel VM-4 has a dynamic range (sensitivity) of 100 db. The Hewlett Packard 8510 is speedy, displaying frequency dependent measurements in fractions of a second. These systems complement one another to provide the DOE with the best available calibration service from 10 MHz to 18 GHz. Measurements of peak microwave power have been enhanced. Recently, a patent on a Peak Power Ratio Generator that measures peak powers in pulse widths down to seven microseconds has been granted. (7240)

- We developed a computer graphics program named CLPLOT that allows numerical control part programmers to check the correctness of their work prior to cutting any metal. This program examines cutter motions in the cutter line file produced by a numerically controlled programming technique before the file is postprocessed to produce the machine-specific control instructions. Using data in the file, the program displays the motions in sequence on a computer graphics terminal at a rate that can be followed by eye. The program features color coded feedrates, zoom, pan, and variable view points. (7480)

- We completed a major software development task entitled Uniform Postprocessor Project (UPP). UPP integrates the postprocessor code for all of the major numerically controlled milling machines in the Mechanical Processing Department and results in improved postprocessor reliability, software maintenance, capability for new machines, and uniform part programmer interface. A direct result of UPP is improved performance in making difficult prototype machined parts that stress the capability of the machines, craftworkers, and programmers. (7480)

considerable flexibility in specific software verification/validation efforts in a hierarchical framework that culminates in the assurance of software quality through code performance sampling by a product qualification team led by our Quality Assurance organization. The approach is patterned after IEEE standards, but is designed to make maximum use of normal software verification/validation activities throughout the DOE complex. Preliminary tests of this approach indicate a potential for decreasing code defects well over an order of magnitude. (7250)

- We developed a video engineering analysis capability that allows computer-generated graphics output data from the Cray computer to be recorded directly on an optical disk. These data can then be randomly previewed by the analyst in either a still-frame mode or a movie mode. With this system, one can quickly

view large numerical data sets, and it is particularly useful in studying time-varying phenomena associated with engineering analysis. (8240/8230)

- A facility composed of IBM equipment and a powerful data base management system was established for engineering information management applications. These applications, currently running on the Sperry 1100 computers, deal with material lists, drawing and engineering release management, and records of assembly data. The new facility establishes an on-line and user computing environment instead of the former batch, operator-intensive, production control environment. The facility will be used to develop a new lead laboratory CIM (Computer-Integrated Manufacturing) initiative — the access, control, and release system for product definition data — for DOE's Nuclear Weapons Complex agencies. (2820)



say, "Well, there's lots of oil in the Middle East and we can always import it," then you don't have a problem. Except that creates some other problems — balance of payments, dependence of national security on foreign sources that are easily interruptible.

LN: *So what should the country be doing to avoid these problems?*

GD: If our national policy is energy independence, we ought to be doing something to achieve it. Once you've said that, the answer is obvious: We have two sources of energy *within* this country that can fulfill our needs for the indefinite future without any inventions or breakthroughs: fission nuclear power (not fusion) and coal. And in neither of those areas are we doing what seems to be sensible. We are turning off all of our nuclear builds and expansion

for what seem to me to be irrational environmental and safety concerns, concerns that seem not to stop the French or the Japanese or the rest of the world from ex-

**If our national policy is energy independence, we ought to be doing something to achieve it. —Dacey**

ploiting their nuclear energy.

And we are not, in my view, doing enough basic research on coal to put us in a position to utilize it as a clean-burning liquid fuel. I'm concerned about that, but I hope and expect that some day our national concerns will restore those programs to where they need to be.

LN: *Was last year's high number of retirements any cause for concern?*

GD: The number of persons who retired was not so large that I think we are having

any real difficulty.

LN: *Is our hiring program continuing to attract the high caliber of people we need to replace those retiring?*

GD: It may be a sign of advancing senility but, nevertheless, I continue to be astonished at how bright these new people are. Somehow I thought that the vintage year of 1942, when I got my bachelor's degree, would never be exceeded, and that all those youngsters would never be able to match the golden years of my own career. But, in fact, it's astonishing that these people know much more than I do. Every generation of technical people seems better than its predecessors, so I think that in the long run the replacement of retiring people with new blood is really going to be good for the Laboratories.

*(Continued on Page Six)*

## Meet Sandia's New President

LN: *Mr. Welber, do you have specific goals for your term of office?*

IW: I'd like to enlarge and diversify to the extent that we can maintain a full mission, as we have in weapons, but I have a strong feeling that, with the budget deficit that we face over the next five years, the administration is going to examine the weapons program very carefully, and the program may have to share in reducing the deficit. If it does, we — Sandia and the other national laboratories — will be affected. I would like to have us in a position whereby we have work that can serve the national interest and yet keep our organization healthy and moving forward. The main purpose is to serve the national interest. If we do that well, I think we'll keep the organization healthy.

As to what those options are, energy is certainly one. Today it isn't recognized as a problem. But it is going to be a problem, and I hope we'll be ready to serve the country with new energy initiatives when the time comes.

LN: *So you intend to continue the direction that George has gone — keeping our energy program viable?*

IW: Absolutely. I would like to keep it as viable as we can and reassure the people working in that area that there is a future. That's very important, very important.

LN: *On February 3, will the transition from Dacey to Welber be noticeable?*

IW: I think it's going to be very smooth. After all, I've been on the scene since October 1. George and I have been able to discuss the roles that Sandia will play in the future and the issues that are involved. And I've gotten a sense of the place and had a chance to meet many of the people. That's going to make this transition a non-transition.

I'm aided in this regard by the administrative side of Sandia. It — finance and budget and public relations and the other organizations that keep the place running — is very professional, top quality. Maybe it's because the administrative side is smaller here, and maybe it's because I've had more contact with it than I had in Bell Laboratories, but I'm

very impressed with how Sandia's run, and how those groups interact with the technical community. They really are players in what we do. When budgets are exceeding the targets, the people responsible on the administrative side make it known and take action with the technical groups. They're not just reporters; they take action. And *that is impressive*. That's what makes this place well managed, because it's not managed only by the technical people — very important.

LN: *From the administrative side — thanks. Have your impressions of Sandia changed since October 1?*

IW: Definitely. I really didn't have that much of an impression before I got here. The mission and the accomplishments of the national laboratories, although their names may be in the headlines, are not that well known in the general scientific and engineering community. I had heard the word "Sandia" for many, many years, of course, and I knew there were awfully good people here, but if you had asked me exactly what they did, all I could say was "weapon systems."

Having now spent some time here, it is clear that the quality of the people is outstanding, on a scale quite comparable to those at Bell Laboratories or any other top-notch R&D organization. The mission is focused, they know what they're doing and they do it very well, they're dedicated — very dedicated — to what they're doing, and the *esprit de corps* is excellent. So my fondest wishes have been fulfilled in finding myself at Sandia. I am proud to join the Labs.

LN: *How would you describe your management style?*

IW: Well, it's basically getting to know the people and learning how they operate and adapting my role to the people who have to accomplish the job. Really, I cannot do anything except try to inspire, try to create an atmosphere where people want to perform good work. And, if I can do that — get people to bring out the best in themselves — I think I'm accomplishing my mission.

LN: *How do you intend to create that*

*atmosphere?*

IW: I do that by trying to elicit from the people involved their views on ways to go. And there are a few principles that guide me in this job. One is, we are a national resource, and we are here to further the national interests by protecting the security of this country. That's really foremost. Another principle is that, as a national laboratory, we must not go into competitive bidding with industry for a job, as we have sometimes been asked to do.

Within those boundaries, then, I simply try to get the best contribution that our people are capable of.

LN: *What's the secret to your success in inspiring the people you're leading?*

IW: I don't know what it is. I'd market it if I did.

LN: *You smile a lot. Can we assume that's a clue to the way you see the world around you?*

IW: I think that to view the environment in a stressful, grim way creates an aura of, maybe not defeatism, but of an inability to control your environment — it's against you, it's hostile. I think, by and large, with good people, we usually are successful in what we try to do unless the environment interdicts us.

LN: *The shadow of Congress, say?*

IW: Or Mother Nature — storms, acts of God.

LN: *But your basic philosophy is a positive one.*

IW: If you picked that up, that's wonderful. And if you want to pass that along, that's fine. I need all the help I can get.

LN: *One final question: how do you feel about your new assignment?*

IW: A year or two ago, I said to my wife that the only thing that could really change my future plans would be to be offered a job at Sandia. I didn't even say president, just "a job at Sandia," I said, "but that's impossible." But, I said, that might change my plans. And, lo and behold, it came to pass.

Again, I did not lobby for the job, I did not seek it, but having been offered it, I will serve. And with pleasure.





WEARING THE APPROPRIATE GARB, George showed off the award DOE presented Sandia in 1983 for turning down its thermostats.

LN: We're just replacing those who are leaving, not increasing the number of employees on-roll, right?

GD: Well, our long-term plan is to maintain about 8400 FTEs [full-time equivalents] over the next several years. The 8000 to 8500 range seems to be what Tom calls a kind of critical mass.

IW: We've been flexible in the past, of course. If it is deemed advisable for us to grow, we'll grow. But there is a manageable level at which you can run an enterprise and

**Growth for growth's sake has never been part of Sandia's ethos. —Dacey**

make sure you're managing it properly, and everybody is gainfully doing a job they can be proud of. We figure 8000 to 8500 is the right ballpark for this kind of organization.

LN: So we're pretty well locked in at this level?

GD: Well, as I said earlier, "Man proposes, God disposes." But I don't anticipate any major fluctuations over time. Growth for growth's sake has never been part of Sandia's ethos. I have felt, and I suspect that Irwin will feel, that it is better to manage an absolutely top-notch laboratory of 8000 people than to manage a second-rate laboratory of 80,000 people.

LN: Will we be able to retain the top-notch people we're hiring?

IW: Only if we stay healthy and maintain a good balance of programs and our output is desired by our customers.

LN: Let's talk about that. What happens if the weapons business is reduced?

GD: If there is to be a fall-off — and I'm not saying there will be — it probably would begin in FY87 when some of the existing programs begin to terminate. Whether there would be that many new Phase 3s is still problematical.

LN: Will we be increasing the amount of effort that we put into advanced development, or do you see that staying at a fairly constant level?

TC: We're struggling to hold it constant at this point. The committed work load, especially in Albuquerque, is very large now. We are straining to maintain a good level of exploratory work — it's essential to a laboratory to do that — and we're increas-

ing our effort in SDI [Strategic Defense Initiative] research programs.

IW: The Phase 3s of future years come from the exploratory work we do now; without that you're not going to have anything.

LN: Let's get back to 1985 and talk about energy. What do you see as achievements or trends?

GD: Well, I mentioned the nation's trend toward reducing energy R&D earlier, and that certainly affects us. But let's talk about the bright side. Certainly the WIPP [Waste Isolation Pilot Plant] program has reached a satisfying phase. The work at Carlsbad has resulted in real caverns, with

**It is better to manage an absolutely top-notch laboratory of 8000 people than to manage a second-rate laboratory of 80,000 people. —Dacey**

real instrumentation and real measurements and real results. The wind power program has reached more or less a concluding phase, except that we are now trying to get to a bigger machine with a new vane design, so that's been quite satisfactory. The molten salt experiment at the CRTF [Central Receiver Test Facility] is going well with a consortium of people working on it. So I think the technical progress in the energy programs has been fully satisfactory.

LN: How about the more glamorous areas — combustion and fusion?

GD: In both of those areas, we had a good year and I think are finding ourselves in a very good position. The CRF [Combustion Research Facility] continues to put out a series of very useful technical results. The esteem in which that laboratory is held continues to grow, both nationally and internationally. The quality of the visiting scientists and the work that is published is very impressive. We have, I think, complete agreement from the technical community and from the DOE that growth in that laboratory is in the national interest. It does run up against this problem of budgets and deficits. But that's been a spotlight program again this year.

Our inertial confinement fusion program seems to be on a very fast track right now. 1985 saw the first shot of PBFA-II [Particle Beam Fusion Accelerator], and the year

**We have never been as optimistic about the PBFA program. —Dacey**

brought a series of breakthroughs in focusing ion beams and in the control of pulsed power in PBFA-I, so that I think we have never been as optimistic about the PBFA program. It looks very likely that we will eventually be able to achieve both focusing and energy deposition adequate to produce ignition in a fuel pellet.

And the STL [Simulation Technology Lab] and all of its applications to weapon work continue to move ahead, actually somewhat ahead of schedule, so that the whole pulsed power area, I think, is one of the high spots of 1985.

LN: What about some of the areas of basic research—materials, strained-layer superlattices, some of the things that are more esoteric and maybe more obscure because of that?

GD: Well, you can hardly call the

strained-layer superlattice [SLS] obscure — the scientific community, at least, is in a state of high excitement about this technology, and many other laboratories are now beginning to do work in these same areas. In fact, as you know, Gordon Osbourn [1132] won the E.O. Lawrence award for his SLS work, so it seems to me that the scientific community in general and the DOE in particular are beginning to recognize that we are developing a very important new branch of technology.

LN: Is our artificial intelligence work moving forward?

GD: I think progress in acquiring people and organizing the work has been somewhat slower than I hoped, but I'm sure we'll get there.

LN: What about microelectronics?

GD: Well, of course, you know the RHIC [Radiation-Hardened Integrated Circuit] Lab will be on-stream within about two

## Arms Control, Verification Technologies

LN: Any discussion of SDI as an effective deterrent has to reach the conclusion that the task would be easier if there were fewer offensive missiles on both sides. What are the ramifications for Sandia if an arms reduction treaty with the Soviets were to be negotiated?

TC: The whole matter of arms control and negotiation is clearly something that is getting a lot of international attention. We view the technological aspects of verification treaties as a growing arena for us to work in, one that we think is important and likely to grow.

LN: Are we actively looking for new ways of verification?

IW: We are examining verification strategies that run the gamut of possibilities. Our past experience in Safeguards is proving most valuable here.

LN: One possible outcome of arms reduction agreements is a comprehensive test ban. What would be the effect of a CTB on nuclear weapons R&D?

GD: Well, there are lots of differing views about what would happen under a CTB. It's a least conceivable to me that a CTB would increase the workload at Sandia: our work in verification and control, for example. We would have to work hard to be sure that a CTB was not being violated. It's true also that, absent testing, especially confidence testing of the stockpile, other means would have to be found to provide as high a confidence level as possible, which means the sampling program would likely increase. If the test ban were to last for a long time, the stockpile would have to be remanufactured because of its limited life.

Therefore, the new programs that would be required to assure that the replacement weapons, absent testing, were as reliable as the ones they were replacing represent a whole new area of work. So, I think a test ban taken alone does not necessarily mean a large decrease in the R&D side of nuclear weapons.



years. We don't want to wait for two years to get results, so we hope to be able to work with Bell Laboratories and others to advance RHIC technology. But we see no reason not to anticipate that the next generation of super-hard integrated circuits will turn out to be feasible, and we hope to get to one-and-a-quarter-micron technology, or less, that's radiation hard. The functional capability of such devices, of course, will be an order of magnitude greater than we're able to do today. So, that's an area of great optimism.

### **SDI: An Important Role for Sandia**

*LN: What kind of a growth curve do you see for SDI [Strategic Defense Initiative] work at Sandia?*

IW: I would like to see Sandia play an important role in the SDI program because I think we have something to offer. But I would like to see it done in balance because SDI is one of those programs that are highly subject to the desire and the will of the administration and the Congress. This administration has a strong desire to see it continue, but whether the program will continue to receive full support is yet to be seen.

So for us to make it a major part of our program at this time would be premature. We do have a role to play, and I want to make sure we play it, but in consonance with the health of the organization.

GD: If you look at the SDI program nationally, the major elements have not yet begun to emerge. Thus, it is difficult to select a major role for any player because you're still talking about a great variety of things from which some future selection will be made.

Nevertheless, certain broad themes of Sandia involvement have emerged. One is that we, as a result of our work in nuclear weapons, which would have to survive a Soviet version of SDI, are natural players in the countermeasures game. We do want to look at all the possible ways in which a potential SDI system could be defeated, because, after all, we may be in the position of having to defeat a Soviet SDI system with our weapons.

Another theme is what you might call areas of opportunity — where our particular technological strength and capabilities would make us the laboratory of choice for some element of SDI. That's the area where growth is much more difficult to predict, because there we are not alone by any means.

*LN: Where does the new SDF [Strategic Defense Facility] building fit into the program?*

GD: The SDF building, of course, is required for both of the areas that we just talked about. It has to be understood that, although it's called SDF, it will not be devoted entirely to strategic defense projects: The broad capability of Nevada testing and the implementation of instrumentation for NTS is another part of the mission of that building.

*LN: Do we have any other new facilities on the drawing board at this point?*

GD: The Instrumentation Systems Lab has also been approved for start in 86. My guess is that, with the budget strictures that

## **Technology — and People — Transfer**

*LN: Two years after divestiture, how would you characterize our relationship with AT&T?*

IW: Evolving. We are only now beginning to see some of the impact of divestiture on our relationship. Before divestiture, AT&T was serving the national interest as a good citizen by assuming responsibility for the operation of the Laboratories. With divestiture and also with the recognition of Sandia's excellence in many areas, AT&T now says, "Gee, we continue to want to be a good citizen, but we also must recognize our own competitive needs in the many new markets in which we find ourselves. If technology transfer has become a mission of the national laboratories, we do not want to miss out on the many excellent technical advancements made by Sandia."

*LN: Do you see some logical areas for technology transfer between the two entities?*

GD: Oh, definitely. There are many areas of overlap from the standpoint of technical interest. After all, both organizations wind up with products that are loaded with electronics. Therefore, the semiconductor area, the high technology materials area, the areas of software and implementation of design — all of those things are very much in common, the methods are very much in common, whether the final product is a weapon or a communication system.

*LN: We understand that there is a new arrangement to allow people to transfer between Sandia and AT&T more easily.*

GD: Yes. We now have in final development a transfer plan that will permit people to move back and forth between the two organizations with fewer problems in terms of benefits and so on.

*LN: How would someone here learn of an opening at AT&T or vice versa?*

GD: In my opinion, it is not feasible or desirable to have cross-company job postings. There are still enough differences between the two corporations from a legal, technical, and mission standpoint that cross-company job posting is not feasible or desirable.

On the other hand, as the managements at both places become more familiar with the opportunities for filling jobs by transfer more easily than in the past, I foresee a greater flow of negotiated transfers resulting in synergies that advance the mutual interests of both companies, the employee, and DOE.

*LN: Do you think it's likely that Sandia or AT&T will ever be assigned any patents or rights to inventions or new technologies?*

GD: On the one hand, the position of the federal government in terms of patent waivers is not yet clear. Faced with some legislation [Stevenson-Wydler Act, Bayh-Dole Act], several executive orders, and some recent regulations coming out of the Department of Commerce, the DOE is still trying to decide how to

handle technology that arises in the Department. It isn't clear whether, and under what circumstances and to whom and under what conditions, patent waivers will be granted.

On the other hand, I feel strongly that there is abroad in the land a misconception as to just how much and what sort of technology exists in the national

### **Our job is to do our job. —Dacey**

laboratories for transfer. People think, on the outside, that there are great inventions here waiting to be exploited: That isn't true.

After all, the prime purpose of Sandia is to fulfill our mission — to provide deliverables in weapons and other defense programs. Our job is to do our job. In energy, our job is to generate technology and then get other companies to exploit it, but that's not true for weapons. The technology that emerges from the weapons program, therefore, is a side benefit, a spinoff of what we do. There aren't a lot of unexploited things. The outside world in general doesn't understand that. They're looking for magic.

IW: Technology transfer, sponsored and paid for by government funds and transferred to industry, is a paradox. To be effective it must be proprietary and transferred to a specific company that can — excuse the expression — exploit it. That means you've got to exercise the wisdom of a Solomon in picking out that company.

*LN: Given our many constraints and corresponding pressures, are we still setting the pace for technology transfer?*

GD: Yes and no. Yes, we probably do more technology transfer because, being an engineering laboratory, our technology is closer to the transfer boundary. But do we do as many innovative things as some other laboratories do? No. We are a conservatively managed, disciplined organization, and we haven't adopted some of the innovative things that Los Alamos and Oak Ridge National Laboratories have adopted in the technology transfer area. For example, we have not used private funds to do development work in government facilities to develop a product for outside manufacture.

Also, we feel that employees of Sandia, a mission-oriented laboratory, have a primary goal of applying their talents to the purposes of this laboratory. We do not, therefore, countenance outside consulting to the degree that other laboratories do — for pay. We do not grant service credit for people who work on the outside in their own private companies. Again, that seems not a business-like arrangement.

So if you look at what some of the other laboratories are experimenting with as a means of enhancing technology transfer, I don't think we're leaders. We're leaders only in the net results of the technology that gets transferred.



we see, it will be difficult to get any other major facility over the next year or two.

LN: You, then, see a leveling off in the building program?

GD: Yes, I fear so. I say "fear" because the need is still there. We still need to replace a large number of buildings from the World War II era, and we still need very badly to refurbish many of the buildings built some years ago. So, the need is definitely there for both new and refurbished buildings.

### Good-bye, George

LN: What do you intend to do in retirement, George?

GD: Well, as I've said in the past, I'm not going to move from Albuquerque, at least not on a 12-months-a-year basis; I'm not going to take another full-time job with some other company; I'm not going to do nothing.

LN: Any positive decisions?

GD: I'm intending to take on a small amount of consulting and other kinds of business activities, and then I intend to let things develop as they will. I've been warned by many friends who have retired that if you don't watch it, you overcommit yourself and find yourself busier than when you were working. I don't want to do that, so I'm going to try to put my toe in the water one inch at a time.

IW: I know from my brief contact with the folks in Washington that George's serv-

ices are in very high demand. I think he will find himself having to turn away far more consulting work than he can handle.

LN: Your predecessor [Morgan Sparks] got involved with community activities and UNM. Would you consider that?

GD: It'll be impossible to disengage completely from all the things I've been doing for the last several years. Since I intend to live in this community, I will try to remain a good citizen, and that does involve a certain amount of public work.

LN: Are you planning to polish your skills in golf, piano?

GD: My ability to improve in either is strictly limited by natural endowment, so I don't anticipate any vast increase in capability. But I still expect to enjoy those activities.

LN: Are there other hobbies that we're not aware of?

GD: Well, I have acquired an AT&T personal computer. One of the things that undoubtedly will be true in retirement is that the tremendous support structure that has been available to me as head of Sandia will no longer be available. Many people, I think, fail to recognize that the performance that others attribute to them is frequently a result of all the people who are trying to help them do their job. I recognize that; and I know that when all of those support services are suddenly withdrawn, I'll have to find some kind of substitute. I hope

that the computer will, to some extent at least, provide that.

LN: Might you resume the research career you interrupted for your climb up the management ladder?

GD: Well, no, I don't believe I could make a meaningful contribution after all these years away from a research setting. It's not my contention that one has to be young to make scientific contributions — though most of the Nobel Prize winners did their outstanding work before they were 50. I am saying that the experience and judgment that come with maturity are seldom enough, that continuous involvement in one's field is almost mandatory. And, much as I hate to admit it, I'm not sure that re-educating this aging mind is practical.

LN: Do you have any departing message to Sandians?

GD: Let me quote a couple of homilies: I think Polonius' advice to his son, "To thine own self be true," is good. As long as Sandia hews to its commitment to excellence and to performance, I think it has nothing to worry about.

And I'm reminded of the shortest speech that the late Sir Winston Churchill ever made; it was given at his boys' school, Harrow, in 1941. It was, in its entirety, "Never give in, never give in, never, never, never, never — in nothing, great or small, large or petty — never give in except to convictions of honor and good sense."

## State of the Budget

Last year's "State of the Budget" message noted that FY86 was going to be "iffy" — and that was before anyone had heard of the Gramm-Rudman-Hollings Act, which mandates cuts in the federal budget to reduce the nation's deficit.

As is clear from a discussion with Paul Stanford, Controller 100, and Ralph Bonner, Manager of Budget and Financial Planning Department 140, FY86 is going to be tough, FY87 probably — depending on the calibration of the crystal ball used — even tougher.

The problems are compounded by widespread uncertainties about whether the act will stand up in court, whether the President will hold to his plan to increase defense spending by 3 percent, and whether Congress will enact a tax hike (or amend Gramm-Rudman). "It's going to take time to shake it all out," notes Paul.

"We're spending a good deal of time now in answering 'What if?' scenarios posed by both DOE and Sandia management," says Ralph.

"But we're proceeding under the assumption that we face a 5 percent cut in this year's budget," says Paul. "Small Staff has identified cuts by program and committee and has established a tentative plan to reduce the current budget to estimated funding. The plan protects new construction [the Instrumentation Systems Lab and the Strategic Defense Facility] as critical to the vitality and the programmatic needs of the Labs.

"So the 5 percent cut translates into a reduction of approximately 6 percent in purchases and about 250 people in budgeted manpower. I say 'budgeted' because we had planned an aggressive hiring program in order to yield an average of 8420 people on-

roll for the year. We'll now aim at hiring a few more people than will retire or leave; that means we'll hire about 500 while 'separating' [through retirements, terminations, etc.] about 450. It's still a reasonable hiring program, and it will continue."

One way or another, most Sandia programs and activities will feel the effects of the cutbacks. Programs face deferrals,

Budget (in millions)		
Program	FY85	FY86
Weapons	\$513	\$543
Other Defense	66	68
Energy	109	124
Reimbursables	221	235
TOTALS	\$909	\$970*

\*Before Gramm-Rudman-Hollings

Employees (in "full-time equivalents")		
Program	FY85	FY86
Weapons	2416	2472
Other Defense	323	320
Energy	452	447
Reimbursables	867	881
Direct Support	1531	1500
Indirect Support	2828	2800
TOTALS	8417	8420

delays, possibly cancellations. Activities — travel, overtime, acquisition of personal computers, use of contractors — face reductions. "And at least until everything is ironed out, we're holding present budget commitments to no greater than 90 percent of the amount budgeted," says Paul. "So far, at least, we don't plan to cut back on reimbursable programs; in fact, we may accept some increased reimbursable work — as dollars get tighter, we may have more people coming to Sandia because they get 'more bang for the buck' here than at other places."

What about FY87? "Probably the same thing, maybe worse," says Ralph. "We'll

continue to be faced with hard decisions in terms of our priorities, in terms of deciding what work gets done and what doesn't. No one can know what next year will bring, but the reduction level for FY87 could well be greater than this year's 5 percent."

"What helps Sandia to face an uncertain future in relatively better shape than many federally supported organizations is, first, that during the good times we didn't grow unreasonably — as total funding grew by nearly 5.5 percent [as adjusted for inflation], our manpower growth was only about 1.5 percent," points out Paul. "We took advantage of the opportunity to upgrade our capabilities. Otherwise we couldn't handle a larger weapons workload now than we did in 1970 and do it with fewer people — 5000 versus 7000. So when budget crunches come along, it shouldn't hurt as badly. We've planned the growth; we hope to be able to plan a decline.

"Second, Sandia's planning is excellent. We're recognized within DOE, if not nationally, for our planning skills. In fact, we serve as a model for other federal labs. And for good reason — we've been cutting costs even as we were growing.

"And, third, DOE lets us manage our business. That makes ours a historic relationship. [See Blue Ribbon Task Force discussion in "State of the Labs."]

"So, as I reported to Small Staff last week as they approved our tentative plan, 'We're there; we can do it. But I don't want you to go away thinking everything's rosy.' It's tough. After all, a 5 percent cut in a \$970 million budget means almost \$50 million — that's greater than our entire annual budget in our early years."

## Given Crunch, Reasonably Good Shape



## Take Note

The Friendship Force of Albuquerque is sponsoring a two-week, citizens' exchange with Ireland May 17-31. During the first week, FF "ambassadors" will stay with Irish families in the small town of Skibbereen on Ireland's south coast. They'll spend the second week at two bed-and-breakfast locations. Trip costs, about \$1000, cover round trip air fare from ABQ and all travel, lodging, and meals during the second week. Trip application deadline is Feb. 28. If you're interested in participating in the Ireland exchange, call the FF office, 243-6919.

\* \* \*

Jay Chamberlin (6221), Warren Windle (2532), and Johnny Ulibarri (313) will receive Silver Beaver awards (Boy Scouting's highest honor for adult volunteers) at a recognition banquet Feb. 8 at the UNM Student Union. Only nine 1985 award winners were chosen from over 5000 adult volunteers in a four-state area (New Mexico, Colorado, Arizona, and Utah).

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The National Association of Black Accountants (NABA) is providing volunteer income tax assistance to low-to-moderate income (less than \$20,000) recipients during February. NABA members will provide the free tax service each Saturday during the month at the Tom Bell Community Center, 3001 University Blvd. SE, from 10 a.m. - 3 p.m. Call 247-3296 for more info.

\* \* \*

The UNM Office of International Programs and Services is offering Chinese Language classes for children and adults. Pearl Wu, lecturer in Chinese for UNM's Modern and Classical Languages Dept., is the instructor. The children's class (for kids six years old and up) emphasizes writing, reading, and pronunciation — beginning through advanced levels. An adult conversation class concentrates on daily and travel use of the language. Classes meet Sundays from 2-4 p.m. Tuition and books cost \$40. More info from Regina Chen, 298-6477.

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Ed Machin (2544) will conduct the first demonstration and workshop (on round cable design) for the newly-formed Expert Systems Group on Feb. 13 at 9 a.m. in the Technology Transfer Center auditorium. All interested Sandians are invited. If you'd like to get on the Expert Systems Group mailing list, or need help from the group, contact Barbara Nielson (3522), 4-3247.

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Beginning Experiences of Albuquerque sponsors weekend gatherings to help people deal with their loneliness and grief after the loss of a loved one through separation, divorce, or death. The weekend get-togethers encourage participants to share their needs, and allow time for personal reflection and small group discussion. The next weekend program (one of three during the year) is Feb. 21, 22, and 23 at the Centro Pastoral, 7208 Arvada NE. For further information contact Charlie Cooper, 881-0906, or Patricia Martin (3741), 298-7035.

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Parentcraft, the educational division of Family and Children's Services, Inc., offers a variety of workshops on everything from touchy teen topics to potty power. Workshops are held at the Parenting Center, 114 Carlisle SE, from Feb. 17 through May 23 (childcare available for most workshops). Call Parentcraft, 256-1191, for a complete schedule of spring offerings, or drop by the LAB NEWS office, Bldg. 814, for a look at the course catalog.

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The Albuquerque UNICEF Advisory Council is sponsoring a program of international music and entertainment by students of the Armand Hammer United World College of the American West. The program, "Have a Heart for Children," will be presented at 3 p.m. on Feb. 9 at the KiMo. Ticket prices are \$10 for adults, \$5 for children (no charge for children under age three; ticket purchases are fully tax deductible). Funds raised will go to UNICEF programs providing emergency child/maternal care and nutritional assistance throughout the world, as well as to the local UNICEF group for similar assistance programs in Albuquerque. You can purchase tickets at Albuquerque UNICEF headquarters (3232 San Mateo NE) and the UNICEF shop in Old Town (323 Romero NW), or call 843-6636.

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"On the Way Up IV" a one-day seminar to help women increase their career advancement potential, is scheduled Feb. 19 at the Convention Center. LaDonna Harris, president of the Americans for Indian Opportunity, is keynote speaker for the seminar, sponsored by the Albuquerque and Duke City chapters of BPW (Business and Professional Women). Among topics to be covered are workplace communication, management of difficult people, and leadership skill identification. Registration fees: \$35 for BPW members, \$45 for nonmembers. More info from Marcella Florez (310), 6-1695.

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Retiring this month and not shown in LAB NEWS photos are L. P. "Bill" Billmaier (343), Basil Herrera (7813), Grover Hughs (5323), Alvin Kaping (3733), Connie Ortiz (3742), Frank Owens (7213), Jose Romero (7813), Bob Vokes (2601), David Doleshal (7211), and Thornton Steele (3154).

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Red Turner, former general manger of the Credit Union, has accepted a position as manager of the Aerospace Federal CU in El Segundo, Calif.

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The "Albuquerque Solarfest" is set for 8:30 to 4:30 on Feb. 15 at the Prep Building on T-VI's Main Campus. Presented by the NM Solar Energy Institute, the event features renewable energy and energy conservation seminars, information, exhibits, and both commercial and non-commercial displays. New this year is a "Solar for Kids" exhibit. For more info, call the Sun Dial (800/432-6782).

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## Events Calendar

Jan. 31-Feb. 8 — "Top of the Charts," Top 40 tunes of the 1950s and 1960s; 8:15 p.m., Jan. 31, Feb. 1, 7-8; 2 p.m., Feb. 2; 2nd Story Arts Center, Albuquerque Little Theatre, 242-4750.

Jan. 31-Feb. 9 — "Foxfire," Tues.-Fri. 8 p.m., Sat. 6 p.m. & 9 p.m., Sun. 2 p.m., Albuquerque Little Theatre, 242-4750.

Jan. 31-Feb. 1 — "Coppelia," Southwest Ballet Company and New Mexico Symphony Orchestra, 8:15 p.m., Popejoy Hall, 294-1423.

Feb. 1 — Charlie Haden and Don Cherry, jazz concert sponsored by New Mexico Jazz Workshop, 8 p.m., KiMo, 848-1374.

Feb. 2 — Showtime at the KiMo: "Big Band Hit Parade," Gene Krupa Orchestra with Carmen Cavallaro, June Valli, and Herb Jeffries, 8 p.m., KiMo, 848-1374.

Feb. 2, 4, 6, & 8 — "Cosi Fan Tutte," Opera SouthWest, 2 p.m. matinee on Feb. 2, all other performances at 8 p.m., KiMo, 243-0591.

Feb. 2 — Annual Candlemas celebration; Picuris, San Felipe, and Santo Domingo pueblos (Buffalo and other dances); contact pueblos.

Feb. 3 — Classical guitar concert by David Tenenbaum, 8 p.m., Keller Hall, 277-4402.

Feb. 4 — Film, "Scotland Forever," narrated by Charles Taylor; Travel & Adventure series, 7:30 p.m., Popejoy Hall, 277-3121.

Feb. 4-5 — "High John Da Conqueror," African American Drama Co.; Feb. 4 at 10 a.m. and 1:30 p.m., South Broadway Cultural Center (free); Feb. 5 at 8 p.m., KiMo (\$5).

Feb. 5 — Concert; Joanna De Keyser, cello, and George Robert, piano; 8:15 p.m., Keller Hall, 277-4402.

Feb. 7 — Showtime at the KiMo: Terry Allen concert (country-western, far-out lyrics), 8 p.m., KiMo, 848-1374.

Feb. 8 — Concert by the Verdehr Trio; clarinet, violin, and piano (Bartok, Mendelssohn, Bruch); 8:15 p.m., Keller Hall.

Feb. 9 — Albuquerque Youth Symphony concert, 3 p.m., Popejoy Hall.

Feb. 11 — Lee Luvisi piano recital (Mozart, Schubert, Chopin), benefit for the Albuquerque Youth Symphony, 8:15 p.m., Keller Hall, 277-4402.

Feb. 11 — Tulsa Ballet, UNM Cultural Program Series, 8:15 p.m., Popejoy Hall, 277-3121.

Feb. 12-23 — "Twelfth Night," New Mexico Repertory Theatre; 8 p.m. (Sat. and Sun. matinees at 2 p.m.), KiMo, 243-4500.

Feb. 13 — Singer-songwriter Phoebe Snow (benefit concert for Alta Mira Specialized Family Services — a consolidation of Albuquerque Special Preschool and Esperanza Para Nuestros Ninos), 8 p.m., Kiva Auditorium, 266-8811 or 873-0600.

Feb. 14-15 — New Mexico Symphony Orchestra concert; Neal Stulberg, conductor; Harry Gorodetzer, cello soloist; 8:15 p.m., Popejoy Hall, 842-8565.

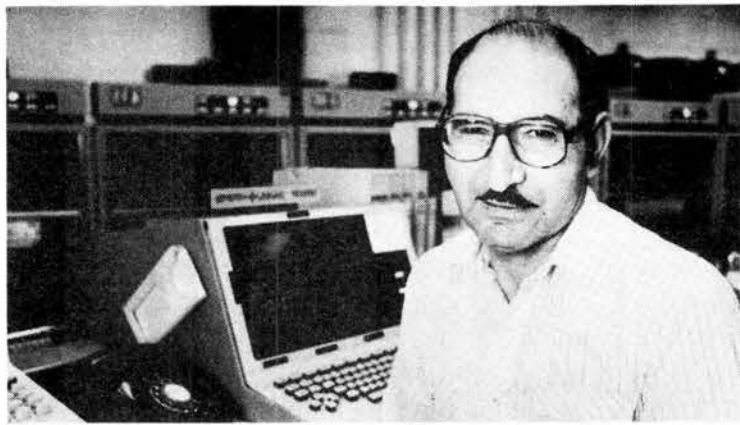
Feb. 14-March 30 — "El Santero Y Su Statue Viviente" and "Don Perlimplin," La Compania de Teatro de Alburquerque; 8 p.m. Fri-Sat., 3 p.m. Sun.; Nuestro Teatro (3211 Central NE), 256-7164.



# MILEPOSTS

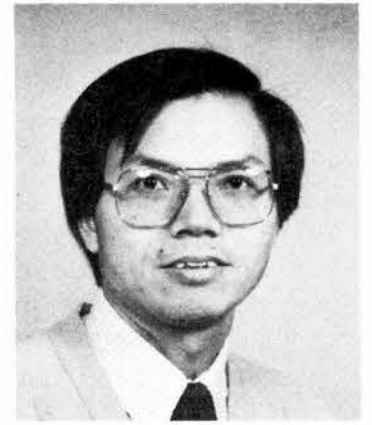
## LAB NEWS

JANUARY 1986



Eloy Montoya (2631)

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Yih-Renn Kan (8241)

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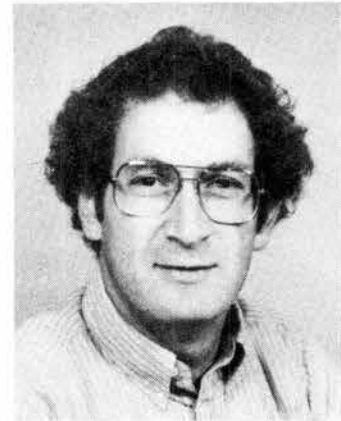
Harry Kovaschetz (7485)

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Bert Tate (7172)

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Larry Weingarten (8242)

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Richard West (2362)

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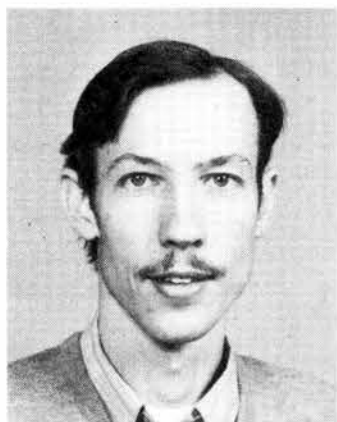
Keith Mead (5163)

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Corliss Fenimore (2632)

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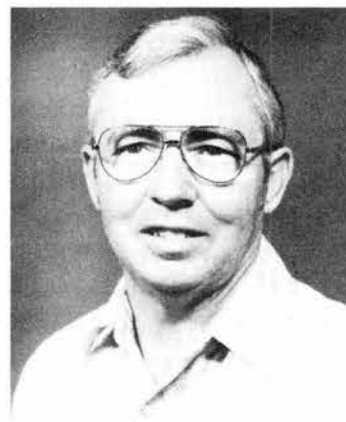
John Didlake (8163)

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Dan Sheldon (7223)

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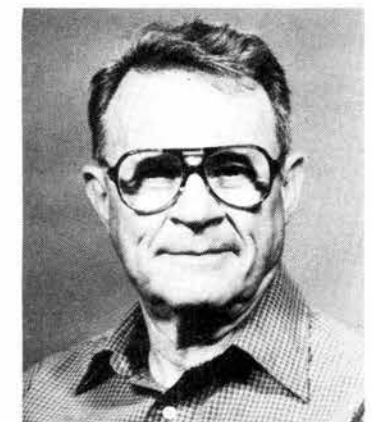
Josef Wintersberger (7481)

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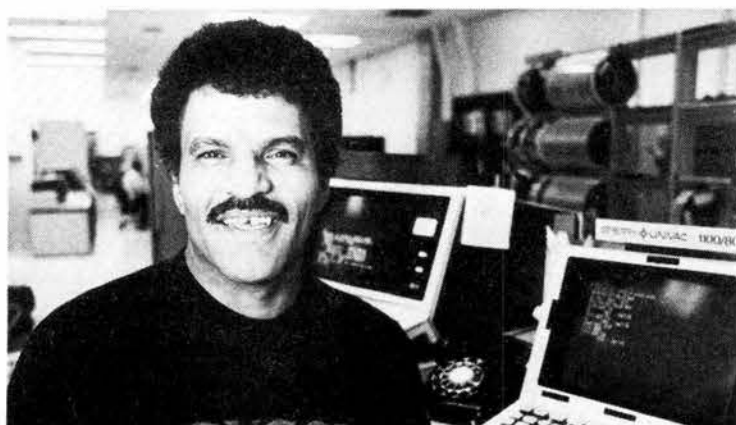
John Wiesen (7200)

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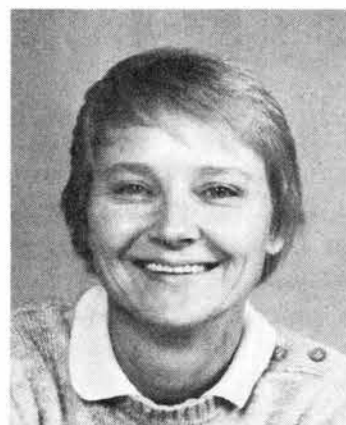
Jim Arnold (5249)

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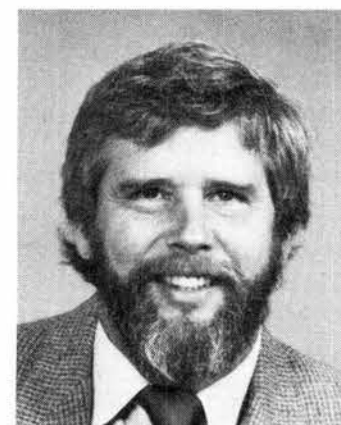
Lance Gordon (2632)

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Susan Gancas (8176)

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Taz Bramlette (8362)

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Marshall Tippy (3442)

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According to some survey or other last year, the worst fear of the average American is to talk in public. Even if it's true, the one thing Sandians are not is average.

Prove the pollsters wrong by calling Bob Austin (3163) on 4-2282 and signing up for Sandia's Speaker Bureau. Just tell him a technical- or career-related topic you'd like to talk about. And he'll match

you with a group that's looking for a speaker — schools, professional societies, service clubs, church groups, whatever.

## UNCLASSIFIED ADVERTISEMENTS • UNCLASSIFIED ADVERTISEMENTS • UNCLASSIFIED ADVERTISEMENTS • UNCLASSIFIED ADVERTISEMENTS

**Deadline: Friday noon before week of publication unless changed by holiday. Mail to: Div. 3162.**

### Ad Rules

1. Limit 20 words, including last name and home phone.
2. Include organization and full name with each ad submission.
3. Submit each ad in writing. No phone-ins.
4. Use 8 1/2 by 11-inch paper.
5. Use separate sheet for each ad category.
6. Type or print ads legibly; use only accepted abbreviations.
7. One ad per issue per category.
8. No more than two insertions of same ad.
9. No "For Rent" ads except for employees on temporary assignments.
10. No commercial ads.
11. For active and retired Sandians and DOE employees only.
12. Housing listed for sale is available for occupancy without regard to race, creed, color, or national origin.

### MISCELLANEOUS

DRAPERIES, lined, gold antique silk, floor length for 10' + width with 13' swag valance, includes rods, \$250. Gardner, 293-8617.

CARD TABLE/CHAIRS, dining room chandelier, dry bar, twin mattresses, aquarium w/stand. Carson, 292-5553.

CAR-TOP RACK, two, 54" long, on-roof bars w/padded feet; 60" cargo tie-down straps, \$15. Schkade, 292-5126.

WASHING MACHINE, 3 years old, needs boot, \$75. Cooper, 888-0967.

CABOVER CAMPER, sleeps 5, kitchen and bathroom facilities, \$500. Bell, 268-2744.

ADMIRAL REFRIGERATOR. Baumgardner, 265-7024 after 5.

DINING ROOM FURNITURE, trestle table, 64" x 100", seats 12, 6 ladder-back chairs, matching 61" buffet, nutmeg finish, \$850. Holmes, 292-0898.

X-C SKIS, Atomic CCS Leaders, 200cm, 10mm sidecut, offset steel edges, telemark & backcountry ski, w/75mm bindings, \$70. Ritchey, 268-7620.

DUAL KING BOX SPRINGS/MATTRESS, firm, trade for queen, or \$200 OBO. Sharp, 293-1824.

SONY TV CAMERA, \$750; Sony portable VCR, \$500; both for \$1100, new cost \$2800. Kjeldgaard, 268-8835.

HEATHKIT 25" color TV, \$275; 36" brass lamp, \$35; green ginger jar lamp, \$15; baby buggy/stroller, originally \$75, sell for \$40. Baldwin, 821-5924.

SEARS 15" color TV, works but needs adjustment, \$75. Simons, 821-9343.

PLAYPEN, \$15; swivel kitchen chairs, \$5 each; chicken/duck plucker, \$50 (new \$350). All items best offer. McFadden, 293-7177.

HEWLETT-PACKARD digital cassette tape drive (HP-IL), Model HP-82161A w/9 tapes, \$325 for all. Juhasz, 247-2416 or 296-8077.

FOUR 33 x 12.5 x 15 all-terrain tires on 10 x 15 chrome spoke rims, \$195 for all. Nelson, 881-0148.

RIMS, 14", 5-hole Chev. (4 each), \$6 each or all 4 for \$20. Marquez, 344-8455.

TENT, North Face, rip-stop nylon, zippered window/door w/bug screens, rain shield, backpacking weight, \$59. Barr, 821-5870.

ELECTRIC TYPEWRITER, Smith-Corona Coronet Super 12, 6 extra color ribbon cartridges, \$100. Smathers, 298-0613.

BOY'S TRUNDLE BED w/innerspring mattress, \$75; fireplace screen, brass w/glass doors, \$50. Byars, 294-6676.

FANCY WIRE HUB CAPS from 1985 Class A motor home, GM 19.5 wheels, \$100. Baca, 265-2881.

30-30 WINCHESTER lever-action, center-fire, carbine, magazine capacity 5, new, never fired, \$200. Csinnjinni, 291-0520.

TELESCOPE, Tasco, 60mm lens, 800mm F/L, two eye pieces, 2X Barlow lens, diagonal prism, erecting prism, tripod, container, \$80. Miller, 268-5992.

FULL-SIZE BRUNSWICK POOL TABLE, 3-piece slate top, all accessories included, must be set up, \$600. Dresser, 821-7292.

KARHU X-C SKIS, waxable, 195cm w/bindings; Fabiano boots, ladies' 9M, equipment used once. Rodacy, 293-2668.

TYPEWRITER, electric portable, Smith-Corona Cartridge, \$50; stereo, AM/FM Sony, \$50; 2 each P185/75 R13 tires w/4-hole rims, \$30 each. Cap, 294-2741.

ORGAN, Baldwin Fun Machine; desk, roll-top; table, hand-made, 3 shelves, one shelf is removable checkerboard. Ottinger, 242-7935.

VIOLIN, one-quarter size, Scherl and Roth, horsehair bow, 4 tuners, hard case, \$175. Berman, 296-5640.

OAK LIVING ROOM SET, 8-piece sleeper sofa, rocker, coffee table, end tables, 2 lamps, hassock, \$380. Hayes, 299-1200.

TYPEWRITER, SCM, electric, Super 12, cartridge, \$150. Blossom, 299-6709.

FREE to very large, very cold doggie: enormous doghouse, needs insulation, 4' x 4' x 5', only loving owners need apply. Maxam, 898-2435.

DINETTE SET, w/4 chairs, \$110; mixed firewood, pickup load, \$18; Polaroid SX-70 w/case, \$35 OBO. Schiess, 255-3252.

DINETTE SET, octagonal table w/leaf, 4 chairs, heavy black metal construction, \$150. Dunlap, 884-0232.

SKI BOOTS, men's 9 1/2, \$20; Samsonite folding chairs, \$10 each; twin innerspring mattress, \$10; hand-crank meat slicer, \$20. Horton, 883-7504.

FLY FISHERMEN: cock pheasant feathers, full skins w/tails, \$7 each. Murphy, 881-1520.

CAGE for small animals, 18" x 18" x 25", water bottle, bowls, bedding, guinea pig food, \$15. Crowther, 821-0172.

KING SIZE WATER BED, corduroy padded side rails, 6-drawer pedestal, large headboard w/side cupboards/shelves and mirror, less than 2 years old, \$700. Mason, 281-3052.

TELESCOPE, Meade 107D, 3 eye pieces, Stitz tripod, star atlas, case, portable for astronomical, terrestrial, photographic use, \$500 OBO. Schneeberger, 256-7013.

AKC OLD ENGLISH SHEEPDOG, male, 10 months old. Dyer, 877-7036 after 7.

COMPUTER DESK, O'Sullivan, big enough for IBM PC, \$50; older IBM electric typewriter, \$35. Phipps, 299-3151.

CHOW-CHOW dog, female, black, spayed, 3 yrs. old, excellent w/children; shepherd mix, female, spayed, 2 yrs. old, both free. Marchi, 299-3610.

SADDLE, Circle Y Western show saddle w/some silver; California-style bridle and reins, \$500. Etter, 294-9604.

FENDER ACOUSTIC GUITAR, w/Fender case, \$225. Yagow, 293-6816.

ANIMAL FLIGHT CAGE, #200 (medium-sized dog), fiberglass, used once, \$30. Klentschy, 265-2016.

SOFA, 6 ft., brick color, \$250. Sons, 294-3953.

SPOTTING SCOPE, Bushnell Sentry 50mm, with 20x and 32x interchangeable eyepieces, protective caps, \$115. Allen, 869-6680.

TRAILER, short wide, recently rebuilt, \$275; two Sears Dynaglas 30 tires on Dodge rims, 3000 miles, \$50 each. Scranton, 869-6589.

TABLE SAW, 10-inch Rockwell, \$150; portable manual typewriter, \$20. Ezell, 821-1768.

ORIENTAL DESIGN RUGS (2), 8 x 10, one mostly blue, one mostly green, \$80 each. Morris, 293-7475.

MUD AND SNOW TIRES (2) and wheels, Semperit 195/70 SR, 14-in. on Toyota rims, \$35. Carkeet, 266-2389.

COMPUTER SOFTWARE, PFS file, report, and write for IBM compatibles, \$405 new, all three \$150. Casper, 268-4464.

BEDROOM SUITE, solid bleached oak, queen size frame, mattress, box-spring, dresser, vanity bench, night stand, \$500. Duval, 881-4406.

UNMOUNTED STEREO SPEAKERS, Electrovoice SP12B, 16 ohm, two-way, 30 watts average, 30-11,000 Hz, 12", new \$220/pr., want \$100/pr. Blake, 881-1663.

NEW RECAPS (2), 750 x 17, one mounted on 8-hole split ring wheel with tube, both for \$100. Hueter, 242-1620.

OUTER'S TARGET TRAP ground hugger and 1 1/2 boxes of clay targets. Wright, 296-3850.

8086 PROCESSOR, IBM-compatible, dual floppy, clock, light slots, macro-keyboard, printer cable and software, \$1599. Zench, 296-4969 between 6-7 p.m.

OAK DESK, refinished; queen sleeper sofa; recliner; double bed with maple headboard; 21 cu. ft. refrig; girl's 16" bike; Panasonic stereo. Buck, 296-5963.

### TRANSPORTATION

BICYCLE, men's 12-spd. touring bike, 27" frame, 1.125" tires, touring saddle or alpine sport, \$125. Schlavin, 299-6592.

RACING BIKE, 22" Trek Reynolds frame, Suntour Superbe components, \$450. Martinez, 822-9802 evenings.

GIRL'S 20" SCHWINN BICYCLE, \$50. Wowak, 298-9398.

3 AUTOS: '66 Dodge, 4-dr., V8; '70 Maverick, 6-cyl.; '76 Bobcat; \$400 each. Breden, 292-0775.

BICYCLE FRAMESET, Guerciotti, 61cm, Columbus SL/DB tubing, stiff frame, \$275. Loucks, 821-9608.

'81 CHRYSLER LeBaron, 4-dr., AM/FM, AC, PS, PB, new tires, 37K miles, one owner, \$4850. Lucero, 299-7933.

'71 CADILLAC Calais, 2-dr., coupe, second owner, \$1500 OBO. Edwards, 291-9046.

'82 BERLINETTA Camaro, V6, new tires, AC, PS, PB, power windows/locks, cruise control, good mileage warranty, \$7595. Weber, 268-0344.

'77 CHRYSLER New Yorker, 72K miles, all power options, 440 4-bbl V8, cruise, stereo, and more, \$2400 OBO. Ennis, 298-3631.

'83 BUICK Century LTD diesel, front wheel drive, AC, PS, PB, AM/FM

stereo, new tires, one owner, 49K miles. Sanderville, 836-5538.

'59 MERCEDES silver 190D, fully restored inside and out, \$7500. Arenholz, 298-1724.

'82 VOLVO 242 DL, 4 spd., w/OD, sunroof, AC, AM/FM cassette, 33.8K miles. Orner, 884-8345.

'74 VW bug; new tires, brakes and upholstery; 94K miles, \$1750. Roberts, 293-3786.

'76 DATSUN pickup, \$1100; Honda ATC, \$395; Yamaha Tri-Z, 250cc, \$1500; 2-burner Coleman stove, \$20. Brock, 865-4055.

'85 OLDS Cutlass Supreme, 2-dr., white w/burgundy interior, loaded, 17K miles, asking \$10,200. Schoeneman, 281-9097.

'83 FORD F100, 18K miles, asking \$5300 OBO. Anaya, 897-3967.

'80 DATSUN 210 Deluxe hatchback, bucket seats, 5-spd., AC, AM/FM, tinted windows, louvers. Sharpton, 897-2883.

'73 BUICK LeSabre, low mileage, equipped for trailer towing, 455-CID engine. Strome, 256-3324.

'80 VW Rabbit, diesel, AC, AM/FM cassette/stereo, sunroof, 85K miles, light blue, \$3000. Lopez, 836-6093.

'73 TOYOTA Corona stn. wgn., 4-dr., roof rack, \$750. Loehman, 265-3179.

'76 TOYOTA LandCruiser, new tires, rebuilt engine, \$4400. Porter, 255-8495.

'76 DATSUN pickup w/shell, 20K miles on rebuilt engine, \$1300 OBO. Blossom, 299-6709.

TAKE OVER PAYMENTS on late model compact cars: Mustang, Nissan or other models. Johnson, 268-0389.

'81 MERCEDES 240D, 4-spd., AC, AM/FM stereo/cassette, sunroof, 28K miles, \$12,000 OBO. Lucero, 888-3294.

'82 HONDA CB750F, 1370 miles, purchased new 9/85, 4-yr. dealer-transferable warranty, \$2300 OBO. Bremer, 291-8297.

BICYCLE, girl's 20" AMF, 3-spd., hand brakes, blue w/chrome fenders, banana seat, \$50. Etter, 294-9604.

'81 HONDA CX500D, plexiglass faring, luggage rack, crash bars, cover, service manual, low miles, \$1100 OBO. Zirzow, 294-7296.

'82 YAMAHA IT250, w/helmet and extras, \$900. Yagow, 293-6816.

'71 DODGE Maxi-Van, 1-ton, engine shot, \$200. Magnuson, 821-5330.

'82 CHRYSLER LeBaron, 2.6 litre engine, 23K miles, new Michelin tires, AM/FM, AC, PS, PW, PD locks, vinyl roof, \$5500. Jaramillo, 255-8288.

'77 OLDS CUTLASS SALON, new front-end work/transmission/brakes, major tune-up, \$2500. Morris, 293-7475.

'79 FORD F-100, AC, PS, tool box, \$1850 OBO. Carkeet, 266-2389.

'75 PORSCHE 914, 1.8 liter, yellow, asking \$3995. Uhl, 298-6391.

'83 BLACK GOLD WING 1110, 22.5K miles, \$4200. Greer, 831-0019.

'66 PORSCHE 912, 5-spd., rust-free. Hill, 299-0019.

'73 OLDS station wagon, 9-pass., needs cosmetics, AC, AT, PS, PW, AM/tape, \$975. Hueter, 242-1620.

'84 HONDA MAGNA, 2.2K miles, 4-yr. warranty, black, \$3200. Jimenez, 299-7203.

'81 CHEVY TRUCK, short wide bed, 3-sp., 46K miles, \$5000. Blankenship, 822-0516.

'68 PORSCHE 912 coupe, red, recently rebuilt engine and transmission, Blaupunkt AM/FM stereo, sheepskins. Dawson, 298-9508.

'78 GRAN PRIX, V8, power, CB, \$2700. Schubeck, 9607 Lona

Lane NE (Spain and Eubank), weekends.

### REAL ESTATE

4-BDR. HOUSE in Rio Rancho, family room w/bar and woodstove, large, fenced lot, no qualifying. Brandon, 892-0449.

'83 14' x 64' mobile home, 1 1/2 baths, set up in adult section of mountain park, \$19,500. Helling, 345-0678 or 281-5536 after 5.

'82 Champion Manatee mobile home, 14' x 70', 3-bdr., near base on landscaped double-wide lot w/storage shed, \$17,000. Piatt, 293-1204.

HOUSE, UNM location, 1800 sq. ft., 3 bdr., 2 baths, fireplace, hardwood floors, garage, basement, fenced backyard, \$89,900. Watson, 256-9241.

3-BDR. HOME, 1300 sq. ft., 2-car garage, great room, fireplace, 1 1/2 baths, extras, Taylor Ranch, \$77,000. Koczewski, 898-2426.

NE HEIGHTS near schools, Wood Brothers tri-level house, 3-bdr., large backyard w/fruit trees, \$94,900. Whitehurst, 299-0153.

3-BDR. HOME, 1 1/2 baths, fireplace, double garage, laundry, 1320 sq. ft., Juan Tabo/Indian School area, \$73,000. Owen, 294-6181.

'84 Champion Manatee mobile home, 2-bdr., qualified buyer take over payments of \$236/mo., nothing down. McKenney, 844-1739 or 268-7390 evenings/weekends.

4-BDR. house, 1960 sq. ft., in New Holiday Park, full security system, solar heat, wood stove, asking \$99,500. Mehlhorn, 294-5685.

'72 AMERICAN mobile home, 12' x 65', 2-bdr., 1 bath, appliances, washer, covered porch, carport, AC, awnings, storms, in adult park. Ridlon, 298-4729.

### WANTED

GARAGE DOORS, two, metal, single-piece, 8' x 8'. Kurowski, 299-9053.

COMMODORE 64 COMPUTER with or without disk drive. Harrigan, 266-4143.

JOYSTICK for TI99/4A. Montry, 821-3758.

TO BORROW OR BUY: manual for Fairchild Model 757 oscilloscope. Hansche, 281-5623.

USED BUILT-IN type dishwasher, "House for Sale" yard signs, plywood. McFadden, 293-7177.

SLIDING GLASS DOOR, 8 feet wide. Coleman, 884-5009.

COMMODORE 64 COMPUTER system; Atari 2600 game computer. McGuckin, 299-1342.

35-MM SLIDE PROJECTOR TRAYS, old TDC (Bell & Howell) type, holds 40 slides. Tate, 299-6813.

RADIAL ARM SAW. Schwoebel, 298-4295.

MALE ROOMMATE, furnished townhouse, 3-bdr., 2 baths, \$250/month. Hesch, 268-6122.

DATSUN PICKUP BODY PARTS, '69-'73, front fender (pass.) and bumper, Model 521, in reasonable shape, will remove. Blake, 881-1663.

CANADA GOOSE DECOYS, plastic, full-bodied w/removable heads. O'Bryant, 268-9049.

### SHARE-A-RIDE

WANT TO FORM CARPOOL, Santa Fe to/from Sandia. Acton, 988-1479.

RIDE WANTED FROM NORTH VALLEY, vicinity 4th and Osuna, will pay \$3/day. Finger, 345-6865.

RIDE NEEDED between New Holiday Park area (Manitoba & Cairo) and Bldg. 832. de Barkoczy, 296-8756.



## Folk Heroes On Big Screen

AMERICAN FOLK HEROES will be in the spotlight tomorrow night, Feb. 1, at Family Variety Night. The Disney animated film, "Festival of Folk Heroes," features the likes of Pecos Bill, Casey Jones, Paul Bunyan, Windwagon Smith, and Casey of Mudville fame. A low cost buffet with goodies like pizza-by-the-slice and hot dogs starts at 5 p.m.; Casey and friends entertain at 6 on the big screen. Film admission is free to all Club members.

IT'S PRIME RIB or scallops tonight on the two-for-one dinner special for \$14.95; other entrees also available. "Enchantment" (from the Land of?) provides the music afterwards from 8 p.m. to midnight.

IT MUST BE SNOWING somewhere, because the Coronado Ski Club has a full schedule of trips planned in February; Feb. 1, Taos; Feb. 2, Angel Fire; Feb. 7-10, Crested Butte; Feb. 14-17, Telluride; Feb. 21-26, Steamboat; Feb. 22, Angel Fire; and Feb. 23, Taos. The Club's monthly meeting is Feb. 18 at 7 p.m. in the ballroom. More details next issue.

THUNDERBIRD CARD PLAYERS continue their efforts to stay ahead of those sharks in Las Vegas by meeting twice in February — on the 3rd and 17th. Come on out at 10:30 a.m. both days (Eldorado Room) to sharpen your table skills.

MORE T-BIRD NEWS — Something new has been added, and it's a real winner! Italian food is on the menu at the first of a series of ethnic buffets/dances on Tues., Feb. 4. The buffet, featuring filet of sole parmigiana, chicken cacciatore, rice pilaf, and broccoli Normandy is served from 6-8 p.m. Afterwards, the Old Cooters (is that name for real?) entertain with real Italian country-western shuffle music for dancing. If you've never seen the Italian shuffle,

you're in for a real treat! T-Bird events are open to all Club members; you don't have to be a Thunderbird, old coot, and/or retired to join the fun. Reservations at the Club office, 265-6791. (By the way, our informants tell us a Greek buffet is in the works for March. You read it here first.)

VALENTINE'S DAY is not that far off, so you'd better be making plans right now for the big Sweetheart Dance on Feb. 15. A super buffet featuring BBQ ribs or chicken and all kinds of accompanying goodies is on tap from 6-9 p.m. Don Lesman and his big-band-sound group play, starting at 8. Sign up now at the Club office.

A WEEK FROM TONIGHT, Feb. 7, the two-for-one dinner special highlights prime rib or swordfish. Two dinners for the low, low price of \$14.95. Western Flyer takes off with the dancing music from 8:30-12:30 that night.

THE C-CLUB OFFICE CREW is tops in efficiency — we all know that. But they don't have ESP. If you have moved, and wonder why you're not getting your monthly calendar of events, it may be that you haven't told anybody about your new address. Give the office a call at 265-6791 to get things squared away.

IT'S NOT TOO EARLY to start thinking about those lazy, crazy days of summer! Pool and patio passes for 1986 are now available from the SERP office at the Club. This year's fees:

Individual - \$15

Couple - 30

Family of Three - 45

Additional Family Members - 5

Swimming lesson registration day is May 3 from 9 a.m.-12 noon. You'll need a pool pass to register.

## Community Focus Series

### Aging — Our Parents, Ourselves



Joan Guntzelman, counseling psychologist, will present the next talk in the Community Focus series on Tuesday, Feb. 11, at 12 noon at the Technology Transfer Center.

Her talk, "You and Your Aging Parent," will address the concerns of members of the so-called "middle" generation who find themselves attempting to cope not only with their own aging, but also with the aging of their parents. Aging brings changes, fed by a wide range of emotions and concerns — changes that raise a number of questions. Guntzelman will focus on managing these concerns in a healthy and productive way.

Guntzelman, who's on the staff of the Stanley Caplan & Associates counseling organization, has her MA in clinical psychology from Xavier University and her PhD in counseling psychology from UNM. She was the director of the Counseling Department at Presbyterian Hospital from 1980 to 1983 and has served as a consultant to Southwest Community Health Services for the last couple of years.

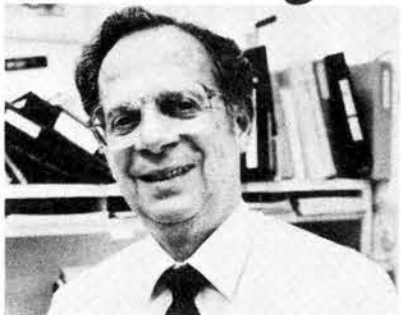
Karen Shane (3163) is hosting Guntzelman during her visit to Sandia.

## Congratulations

Charlotte and Victor (3426) Lovato, a daughter, Adelina Andrea, Jan. 8.

Eleanor and Dan (6422) Lucero, a son, Daniel Thomas, Nov. 12.

## Retiring



Sid Gasser (2613)  
32 yrs.



Bob Butler (7233)  
31 yrs.



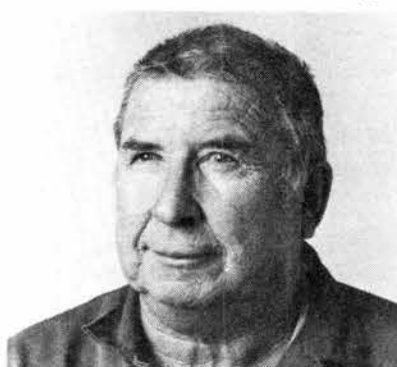
Warren Taylor (7241)  
33 yrs.



Jim Arnold (5249)  
30 yrs.



Mel Rushing (2833)  
31 yrs.



Bill Moore (7171)  
34 yrs.

## Format of This Special LAB NEWS

This LAB NEWS is actually three issues in one — peel off the outside eight pages and the standard LAB NEWS is complete. The next eight-page section is the annual "State of the Labs" issue, featuring President George Dacey, incoming President Irwin Welber, Executive VP Tom Cook, and Controller Paul Stanford. The remaining pages are the complete Technical Accomplishments 1985 special section. The LAB NEWS design for this edition enables additional copies of the individual sections to be printed separately.